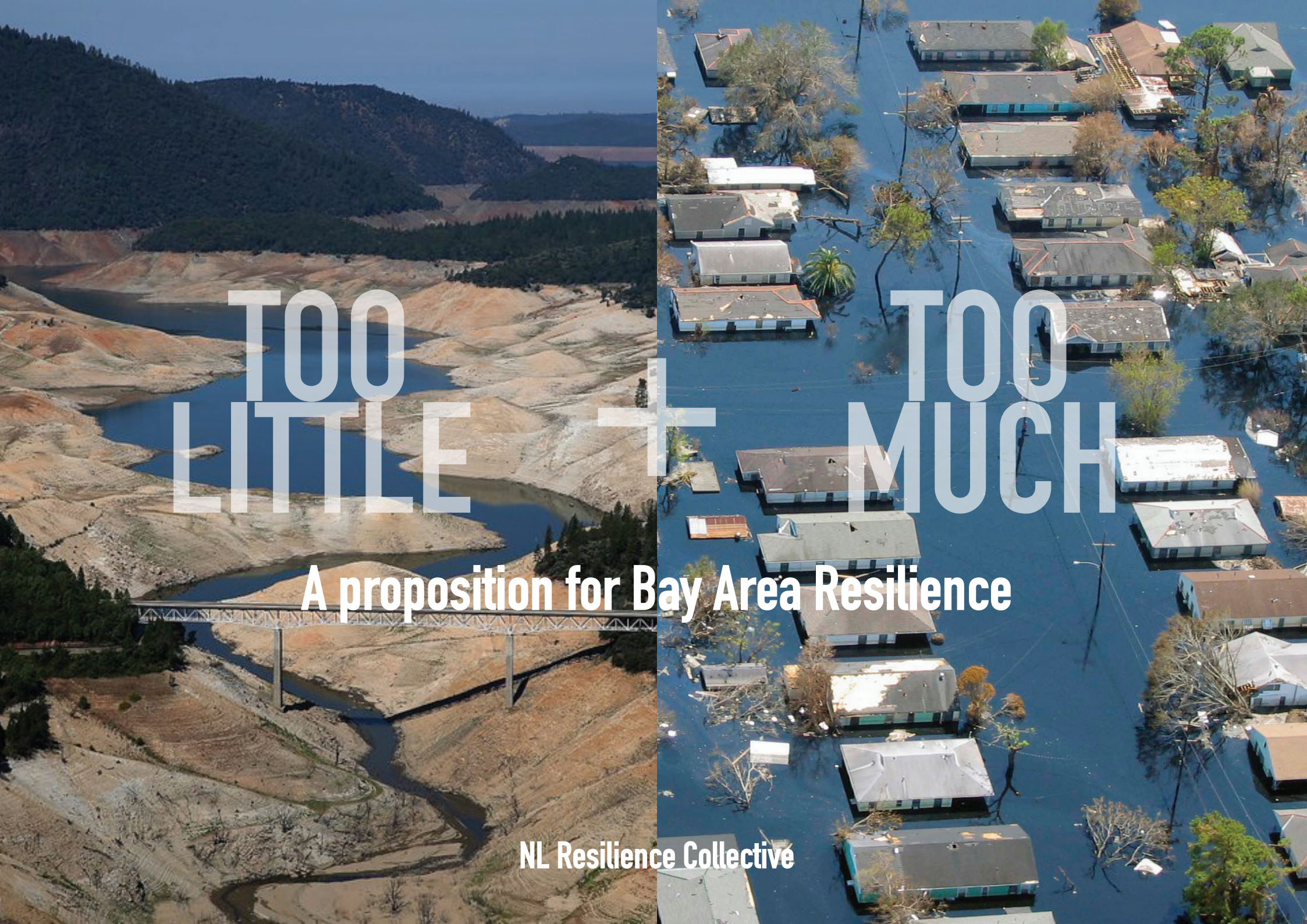

TOO LITTLE + TOO MUCH

A proposition for Bay Area Resilience

NL Resilience Collective

The Bay Area faces a challenging future. Problems that currently exist in only a few areas, will affect the entire Bay Area in the future. Challenges that may not seem so urgent today, will have huge impact on daily lives tomorrow. So what kind of challenges are we talking about? And what are tools we use in the Netherlands to deal with similar issues? Let us guide you through our story of the future Bay Area. The NL Resilience collective is composed of the following entities, globally working on integral solutions for resilience:

mobility consultants
Goudappel Coffeng

Deltares
Enabling Delta Life

MVRDV

one architecture

Kingdom of the Netherlands

Executive Summary

A proposition for Bay Area Resilience

Executive summary

The Bay Area, which holds one of the world's strongest economies and is home to over 7 million people, is an area of extreme beauty and diversity. It is also an area that is extremely fragile.

Built on two major fault-lines, the area is at risk from earthquakes. Constrained by its geography, the booming economy combined with a challenging regulatory and tax environment have created a housing crisis, growing inequality and, by extension, a transportation nightmare. After more than a century and a half of extractive practices, natural resources are under continued stress: many former wetlands have been filled, land is subsiding, and the region is too dependent on outside sources of energy and water.

Climate change will exacerbate these stresses. With sea level rise expected to be as much as 6ft by century's end, many of the low-lying areas, which now are home to 270,000 people, both major airports and much of Silicon Valley's corporate campuses, will be regularly inundated, causing estimated damages up to $60 Billion (Pacific Institute, 2012).The marshes that are left are at risk of drowning. With the water blocked from entering the Bay, more intense storms will cause upland flooding. Water and energy supply will become less dependable.

Recent initiatives, such as the Resilient by Design: Bay Area Challenge, have sketched out what climate adaptation in the Bay Area might look like. Cities need to find space for water. Programs will need to move out of the floodplain. Natural ecosystems will need to be restored. The use of resources will need to be sustainable. The nine projects that formed during the Bay Area Challenge demonstrate the need for an integral approach.

It is critical to start implementing such projects, because they will lead the way for the many more that will have to follow. Lessons will be learned, and muscle for adaptation will be built.
In the Netherlands, we have built such muscle for over 1000 years. 'Living with water' has evolved to mean learning to collaborate to stay dry, and appreciate the societal and economic benefits an integral approach to water brings: livable cities, inclusive communities and constant innovation.

At the same time, as Dutch we realize that not all issues can be addressed at the level of the individual projects. Long-term strategies, some at the larger scale, are critical for adaptation.

Over the centuries, we have developed a broad set of social and physical tools (or technologies) that have helped us live with water. By collecting and presenting these tools here, we hope to inspire the Bay Area to work toward the implementation of climate adaptation projects, and to make a start with the development of long-term strategies:

Water management tools

Water management tools have helped us understand the interplay between stormwater, drought, groundwater, drinking water, waste water and coastal water, including future effects of subsidence and sea level rise. This has resulted in management strategies that find a balance between safety, ecology and economic development (in particular agriculture) by working at all scales simultaneously, and by linking governance models to physical measures at the appropriate scale. For the Bay Area, such an approach integrating all water system aspects should result in a better systems level understanding of the hydrology of the entire Bay and delta, and a governance structure that would make it possible to intervene at the same scale.

Sustainable mobility tools

Sustainable mobility tools make it possible to understand the interrelationship between the different modes of transport, and to link transportation planning better to spatial planning. With these tools, it becomes possible to demonstrate the impact of more sustainable modes of transport (walking, biking, light electric vehicles, transit) over cars, and stimulate investments in them (especially since 50% of all car trips in the Bay are less than 5 miles). A host of complementary tools, from integrated fare, management and information systems to the construction of attractive interchange points, both big and small, where people can switch modes, make a modal shift easier and more sustained. This shift will be more comprehensive by concentrating the majority of the land-use development within cycling and walking distance of high quality transit stops. This will increase transport options for people who do not (want to) own a car and make it easier to address the first and last mile problem for longer trips. For the Bay Area such tools could help to improve health and safety, increase resiliency of the network, make the transport system more sustainable and communities more attractive.

Area development tools

Area development tools bring stakeholders and owners together to create diverse urban environments with equitable access, integrated resource management and inviting public spaces. Added value, including economic value, can be best realized between voluntary actors if parties embrace a shared perspective and are prepared to combine their assets - temporarily - to realize that perspective. Climate risks and the related opportunities for a better region are such a compelling perspective. In order that parties understand and experience these benefits themselves, metrics, design and communication need to be developed together. In the Bay Area, intensifying land-use and integrating functions by better collaboration between governments, between governments and private actors, and between private actors, would release much of the land stress, create space for ecosystem services, and greatly reduce development costs.

Inclusive design tools

Inclusive design tools play an important role in developing highly efficient, yet qualitative urban environments in which people with various backgrounds are happy to interact, contribute and live together. They ensure we create places that not only serve technical, economic and environmental requirements, but also respect the individuality of people as well as their needs for privacy and personal outdoor spaces, health care, social amenities and lively community places. Tools such as integral scenario thinking and -visualization, strategic visions and design guidelines also help us to manage serious dialogue between stakeholders, define collective, long-term goals and translate them into each smaller development. This enables systematic change and inclusion through consistently taking little steps by various actors.

Using inclusive design tools in the Bay Area can help to identify and agree on collective goals and join efforts in taking efficient steps towards a resilient Bay Area future. The tools can support the communication process with and between stakeholders and communities to foster awareness, understanding and collaboration. They can set the tone and result in attractive precedents for attractive, inclusive and resilient intensification of existing neighborhoods. Ultimately, this can relief pressure on vulnerable communities as well as on the health care-, mobility- and environmental systems.

What all these have in common is an understanding that risks are best managed (and urban and ecological opportunities are best delivered upon) when a collective perspective, combined with collective action, complements the individual engagement. Effective governance requires collaboration and coordination at every level, including on the level of the overall system. Such collaboration and coordination is helped by clear science and transparent information. The visual tools that design offers greatly facilitate this process. And design helps integrate different aspects and challenges into comprehensive solutions, leading to on-the-ground examples that can be learned from, replicated or scaled.

The tools do not stand on their own. Effective area development goes hand in hand with inclusive design processes and effective mobility management, which in turn results in more space for water and the restoration of natural systems. The ability to use scarce land more intensively and multi-functionally and to allocate programs more appropriately makes it possible to construct more housing in more loved, healthier communities, better manage resources and reduce greenhouse gas emissions.

Roughly projecting these tools on the Bay Area, it becomes possible to imagine:

- Avoiding losses of tens of billion dollars, crippling the economy and keeping 270.000 residents safe from unmanaged future displacement
- Facilitating the implementation of the Resilient Bay Challenge projects while also studying larger scale measures
- A governance model that drives adaptive decision making on land-use in the coastal areas, combining strategies of:
    - Retreat from those areas where natural systems should be restored
    - Development of a 'wet feet strategy' for certain low-lying areas with floating communities
    - Protection and consolidation of program in areas that are well connected by transit.
- The alignment of a land-use strategy with a mobility strategy that focuses on walking, biking and transit to drive a modal shift of 20% from individual cars to other modes over a 20-year period, and the development of new, mixed program around the transit nodes;
    - increasing the density around transit would generate housing for 3 million new residents, while
    - even only using the non-residential areas of the urban fabric can accommodate 500,000 new housing units and 230 million square feet of other space, allowing for healthier economic growth while relieving housing stress
- Livable and healthy neighborhoods with an inviting public realm with ample space for urban water and collective green areas.
- A resilient water system that reduces storm drainage, restores groundwater recharge and treats waste water such that it can be re-used for irrigation and groundwater recharge, so that groundwater pumping for drinking water is limited to emergency periods only.
- A drastic reduction in greenhouse gas emissions and resource use
- A culture where even small projects contribute to the resilience of a larger system, regulating water management, mobility and community assets through a set of design guidelines.

We hope to help with finetuning and adapting these tools such that they can work in the Bay Area, starting with the following:

Our 5 Recommendations/Actions for a resilient Bay Area future:

1. Update Plans to include water management and climate adaptation

You cannot deal with the major issues of climate adaptation, water management, housing and transport separately as this leads to suboptimal or even counterproductive strategies. Long term plans need to be upgraded and consolidated to a truly integrated plan that gives clear directions for transport and land-use strategies that support climate adaptation and water management.

2. Install a Bay Area Resiliency Commissioner

To develop the integrated plan towards resiliency and climate adaptation in the Bay Area, to facilitate open access to and sharing of relevant data and information, and to stimulate regional stakeholders to cooperate and develop adaptation pathways and strategies in line with the integrated plan it is recommended to install a Bay Area Resiliency Commissioner.

3. Understand your system – You can't manage or improve what you don't know

To deal with sea level rise and climate change it is important to invest in data collection and knowledge development about what is happening right now. Especially with respect to the water system there is a lot that we do not know or we do not know precise enough to develop a shared analysis of what is happening and develop effective strategies (e.g. for groundwater levels, surface water quality, discharge and pumping locations). A data collection and monitoring network needs to be set-up to help develop system understanding and monitor the effect of changes, including the implementation of adaptation strategies.

4. Collectively develop a set of design principles for local communities across the bay

Raising awareness and empowering communities, businesses, schools and people with the knowledge and tools to act is crucial. Showing how climate change already influences daily lives today and how serious things could get in the near future will help to increase the sense of urgency. Develop a set of effective integrated design principles together with communities that show how water infiltration, green spaces, active transportation and livable neighborhoods can be tied together and how everybody can contribute.

5. Start both big and small

The huge challenges that the Bay Area faces cannot be tackled bottom-up or top-down alone. Large scale and long-term projects aimed at protecting people and infrastructure are critical for adaptation. At the same time there is a need to start implementing small solutions on local and street scale that contribute to climate adaptation, water management, active transportation and livable neighborhoods. A knowledge center should be developed to allow for the collection and sharing of (progress) data and information between academics, government, the private sector and the public.

Part 1:
Challenges for the Bay

The Bay Area, which holds one of the world's strongest economies and is home to over 7 million people, is an area of extreme beauty and diversity. It is also an area that is extremely fragile.

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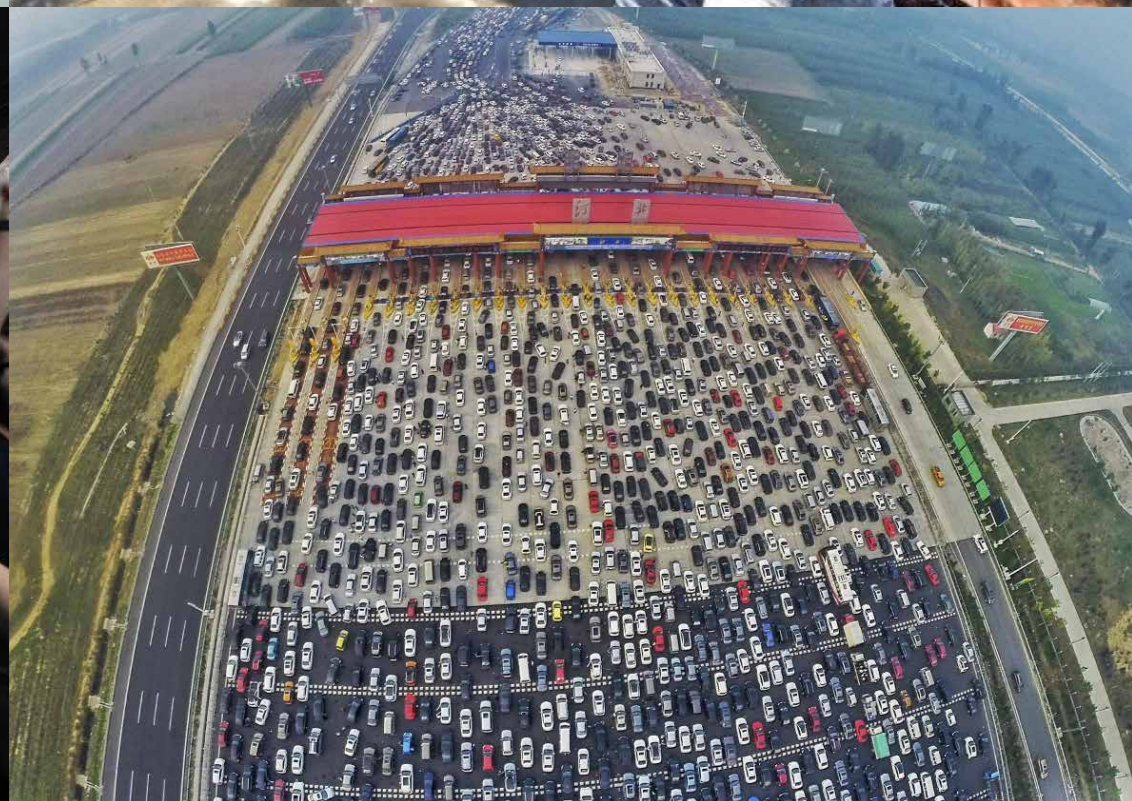
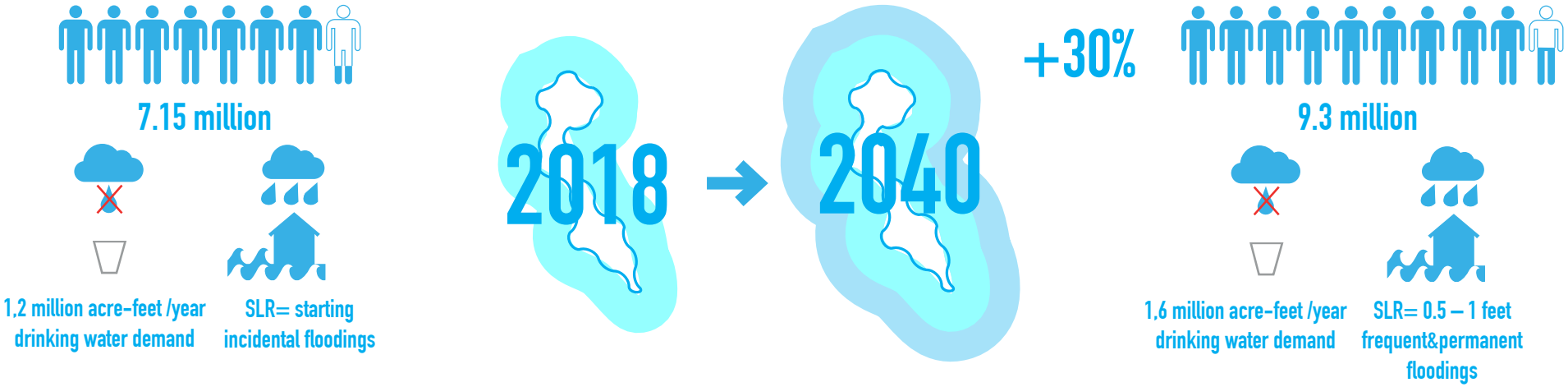
DRUMMERS WORLD
YOU ARE THE 99%
24 HRS



Urgency for action

Too little + Too much



The bay area faces mayor challenges that concern water, both: too little and too much water. Combined with rapid urban growth and the risk of a major earthquake these challenges deeply impact the way people work, live and travel in the Bay Area in the future.

Too much water

Too much water, mainly caused by rising sea-levels and heavier rainfalls. This currently impacts the lowest-lying areas and areas along canalized streams with not enough capacity during heavy storms. These are often areas where the most vulnerable communities are. Soon the problem will affect the entire Bay regional economy, as high-tech companies, international airports and highways find themselves located in critical areas. Major flood events, as we saw in New Orleans and NYC, could be at the Bay Area's doorstep too.

Too little water

At the same time, there is the challenge of too little water, due to increased periods of extreme drought. We already face serious problems in the availability of drinking water today. It is not only that there is not enough water available, but also the water quality is at risk due to pollution and not treated well enough waste water. If we continue to use water at the same rate, Bay Area residents may be severely limited in using water in the coming decades. Imagine being asked to use the shower only once a week or to queue for drinking water!

+ rapid urban growth

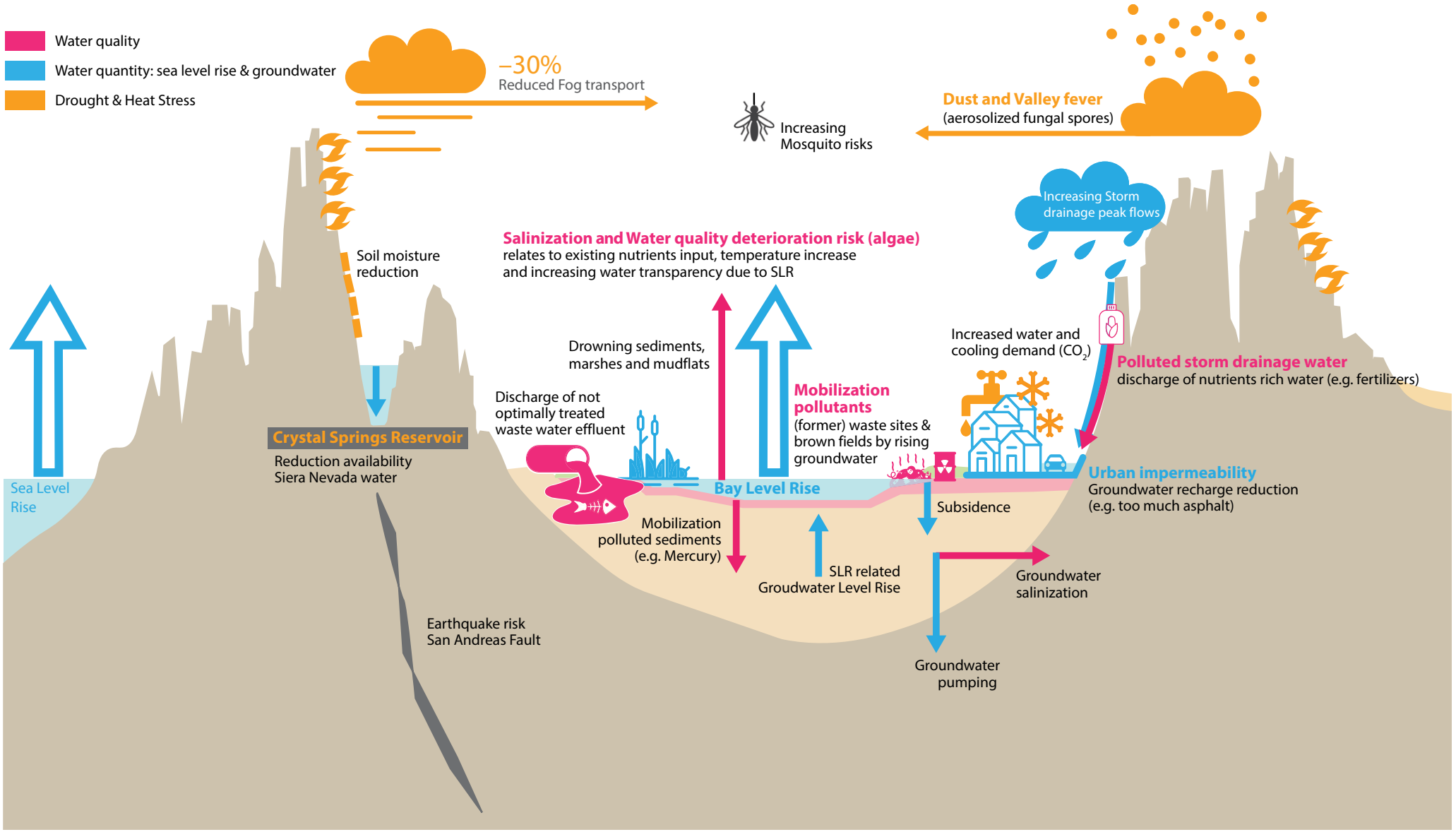
The bay area is expected to grow by more than 2 million people until 2040. Where these people will locate and how they make use of the water system will not only have big impacts on too much and too little water, but also on the already stressed housing market, crowded transport systems and existing social and spatial inequalities in the region.

+ risk of a major earthquake

To top this sandwich of challenges the Bay Area faces a continuous risk of a major earthquake. Rising ground water levels as a result of sea level rise could increase liquefaction risks from an earthquake. Improving the resiliency of the housing stock and transport systems against floods, fires and earthquakes should be combined.

Collective action and strategies needed

These future challenges will severely impact the Bay Area and change the daily lives of the Bay residents. Dealing with these challenges demands long-term adaptation strategies and integrated solutions that deal with issues related to water quality and quantity, housing, transport and resiliency against fire, flooding and earthquakes in a holistic way. This requires a collectively felt urgency by residents, businesses and politicians to act. Business as usual is not an option.



San Francisco Bay area – Summary of main subsurface and water related risks in relation to Sea Level Rise and climate change.

A complex interrelated system:

The whole water system at a glance

Sea level rise and subsidence drastically increase the risks of flooding

The figure on the left page shows all important Sea Level Rise (SLR) and Climate Change (CC) processes in the Bay Area. It shows how too little and too much water are closely interrelated.
Sea Level Rise leads to rising water levels in the Bay, which leads to higher groundwater levels land inwards of the shoreline. At the same time, this area is vulnerable for subsidence typically with higher 'sinking' velocities than the rise of the sea level, putting the coastal areas along the Bay at risk. In time, natural protection provided by marshes and mudflats will reduce due to a lack of sediments and marshes are in risk of drowning.

Urban flooding is related to high Bay water levels and intense rain storms. Peak discharges will increase due to changing rainfall characteristics, existing urban soil impermeability and the effect of concreted and canalized streams. Especially during high Bay water levels and intense rainfall, the urban areas adjacent to the shoreline will become increasingly vulnerable for flooding. Ongoing urban development along canals and the shoreline will put even more people at risk.

More drought, heat and people means higher demand for water and more risk of fires

Drought and heat combined with much more people living in the region will dramatically increase water demand. At the same time, there will be a lack of fresh water resources in general (e.g. lower snow smelt Sierra Nevada). Fires will increase, caused by a combination of heat, drought, wind, reduced fog and above ground electrical infrastructure. With eastern winds, dust and Valley Fever can increase. Extra pumping of local groundwater will increase groundwater salinization. The use of air-conditioning will increase considerably with more dry and hot periods, producing extra CO_2.

Water quality is also at risk

In relation to SLR and CC, also water quality needs to be considered. Because of rising groundwater levels along the shoreline soil pollution (brown fields, waste sites) is at risk of being mobilized and transported through the groundwater. In time, mercury stored in the Bay bottom can be mobilized. The Bay water quality is already threatened by urban pollution, not-treated-well-enough wastewater and pollutants (agro-chemicals) from the San Joaquin River. Now, despite of high nutrient loads algae growth in South Bay is limited. It is thinkable that because of rising Bay levels, decreasing sediment loads and therefore increasing transparency algae growth becomes a problem.

The SLR and CC threats in the Bay area are systematic and interrelated issues that can not be tackled by local solutions only. A systematic, long-term and large scale approach is needed to make the Bay Area resilient in the long run and avoid worsening the situation by well-intended measures.

Sea level rise in the San Francisco Bay area

The rise of mean sea level is considered to be scenario independent up to 2050, with a likely range of 0.6-1.1 feet. San Francisco is located in a sea-level rise hotspot and will experience above global-average sea level rise. This is related to the contribution of the ice sheets of Greenland and mainly Antarctica to sea level rise in San Francisco. The precise future behaviour of those ice sheets is highly uncertain, recent studies show that they will potentially contribute a lot more to SLR than considered so far. High-end scenarios project a possible increase in mean sea level of 3.5 to 11.9 feet for 2100 and 5.8 to 21.9 feet in 2150. Those high sea-levels are without fluctuations due to king-tides and storms, extreme end-of-the-century sea levels might therefore even be higher than shown below.

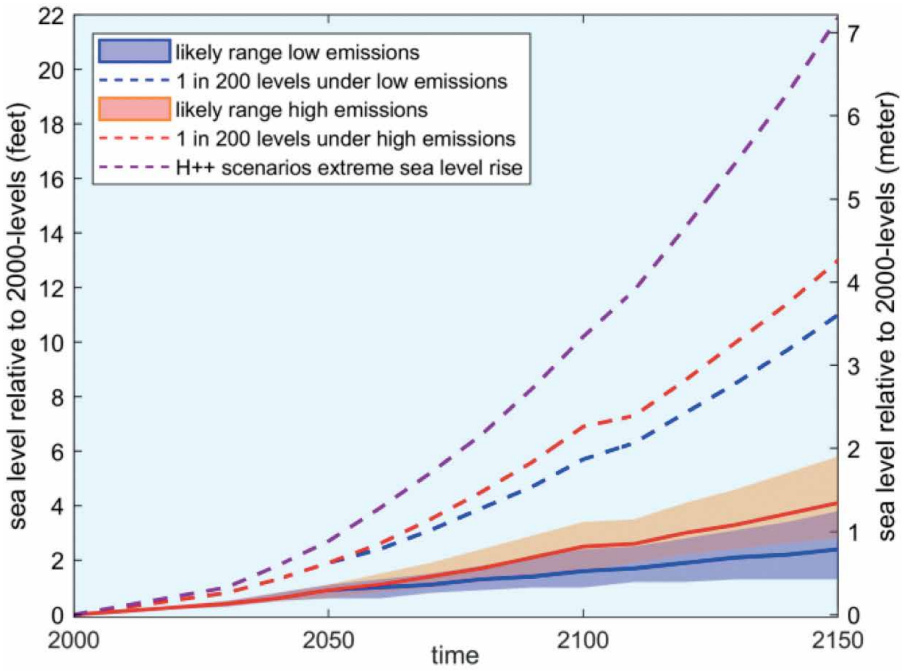


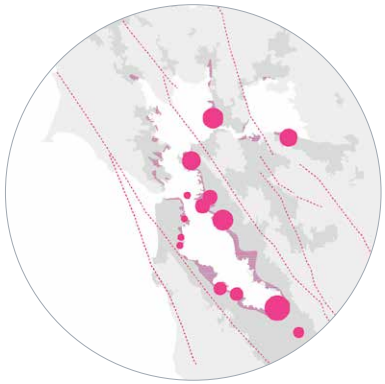
Figure 1. Sea level rise projections for low and high emission scenarios. The dotted lines represent sea levels with a smaller likelihood. Scenarios are adopted from 'State of California Sea-level rise guidance, 2018 Update'.

TOO MUCH

+

TOO LITTLE

Increase in Sea level rise

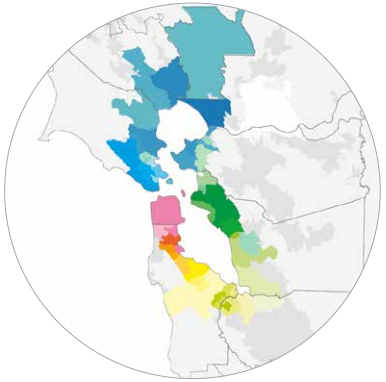


Highest impact on vulnerable communities & economies

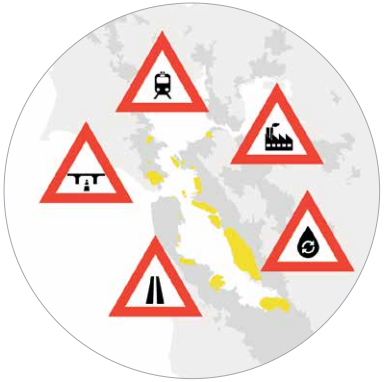
Further Displacement, segregation & lack of facilities

Increase of commutes & asphalts

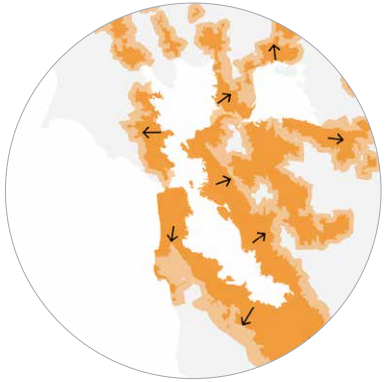
Fragmented policy making & lack of integral, systematic cross-border maintenance



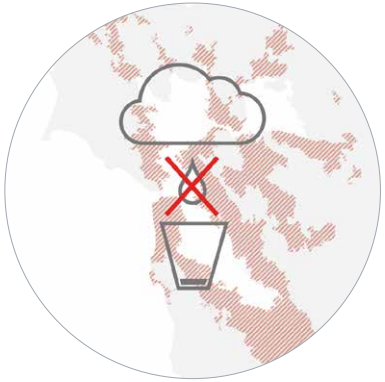
Increase in aging assets and outdated facilities



Additional growth in conventional models



Increased water demand, drought, groundwater shortage & subsidance



How does a water system inbalance engrave other problems in the Bay Area?

Impact of water on other Bay Area systems

The increased complexities of too much and too little water in the Bay Area also deeply affect economic development, the transport system and aggravate existing social inequalities. At the same time the current land-use patterns and transport system also contributes to problems with the water system.

A transport system based on cars is no good for water and people

Increased risk of flooding and more dry and hot periods puts more strain on the robustness of a transport system that is already facing difficulties with lack of funds to improve aging assets. At the same time a transport system that is too dependent on cars and asphalt causes heat islands, limits opportunities for water infiltration, thus increasing flood risks and affects water quality due to dirty run off water from main roads. Furthermore, a transport and land-use system that is too dependent on cars promotes lower densities and spatial separation of activities, thus increases commuting distances. It produces incredible amounts of Co2 and dramatically decreases accessibility for people who cannot afford a car.

Land-use does not help the water system

Low density homes with large lawns consume much more water than homes in higher density mixed use neighborhoods. Almost all easily developed land had been built up with predominantly low or medium density housing, commercial and logistics. The natural flow of creeks has been blocked off or canalized with concrete walls and the salt ponds. There are to many streets without trees to hold water or offer shade. There is not enough open and green space close to where people life, or these green spaces are private golf courses that consume lots of water.

Vulnerable communities at risk

The enormous economic development and influx of people in the region on the one hand leads to displacement of vulnerable communities to the outskirts of the region where they are confronted with long and costly commutes, heat and drought. Or they get concentrated in small unattractive pockets within the region that puts people's opportunities and health at risk because they are vulnerable for flooding, suffer from air and soil pollution and lack of access to amenities, good education and open space.

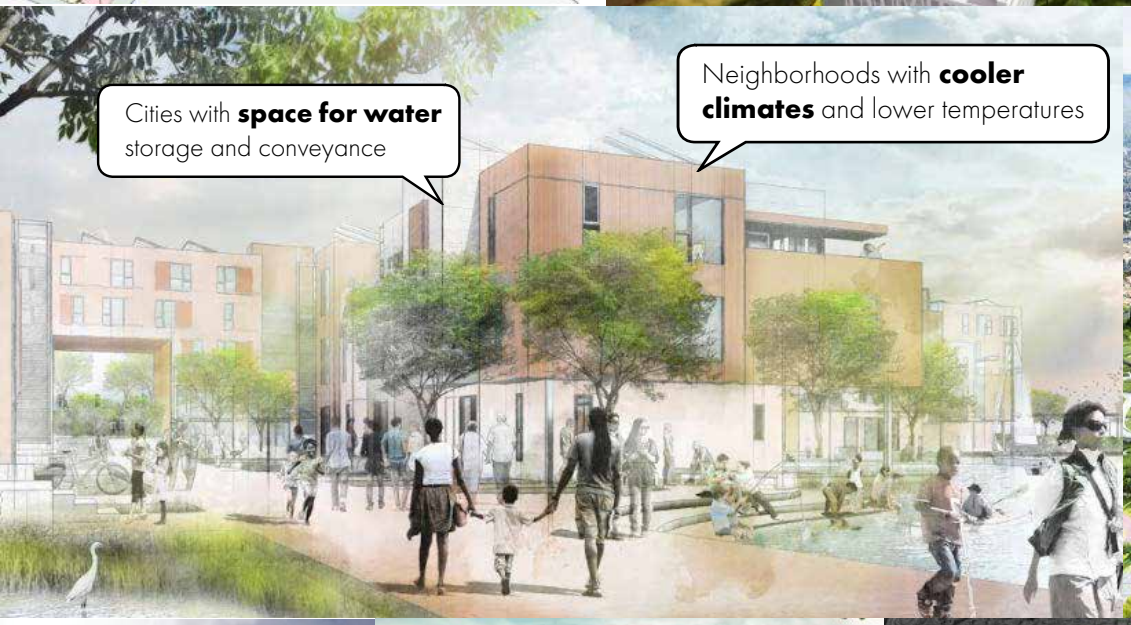
Fragmented policy making

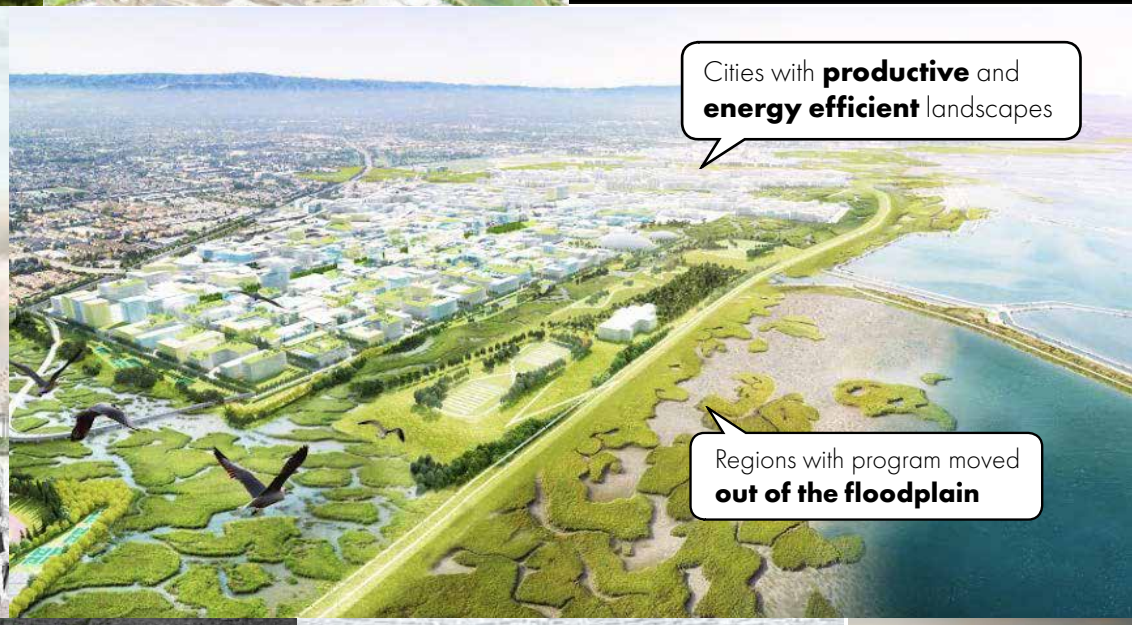
At the moment there is no integrated approach to combat climate adaptation, transport and urbanization together. Many organizations, constituencies, cities deal with these issues together or separately but there is no overall picture that fits these different strategies together. There is a strong focus on projects and who benefits or pays for these projects. Do only people directly affected by flooding have to pay for protection? Do new major transport infrastructure projects contribute to climate adaptation and reduce flood risks?

Learning from Resilient by Design

Recent initiatives, such as the Resilient by Design: Bay Area Challenge, have sketched out what climate adaptation in the Bay Area might look like. Cities need to find space for water. Programs will need to move out of the floodplain. Natural ecosystems will need to be restored. The use of resources will need to be sustainable. The nine projects that formed during the Bay Area Challenge demonstrate the need for an integral approach.

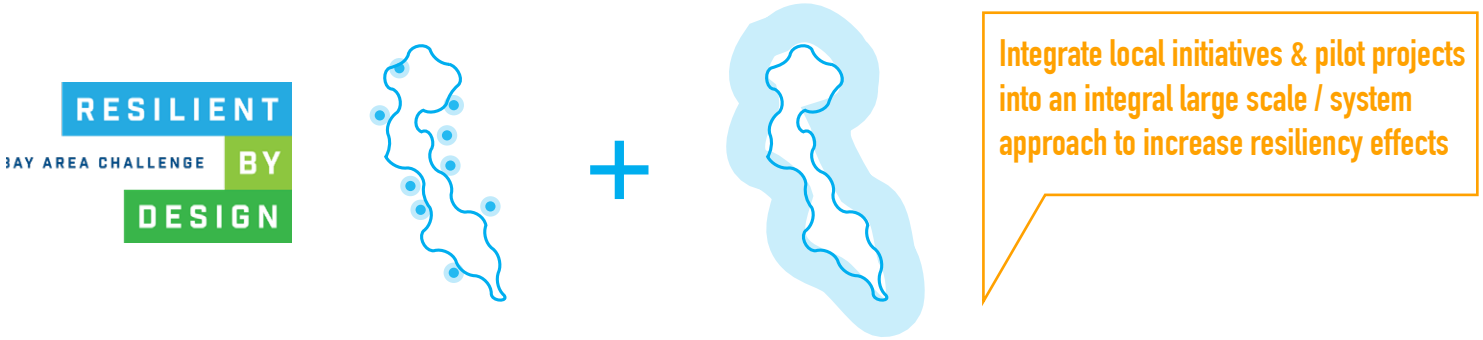
It is critical to start implementing such projects, because they will lead the way for the many more that will have to follow. Lessons will be learned, and muscle for adaptation will be built. This muscle can support the formation of a strong vision on resilience for the overall Bay Area.


Cities with **space for water** storage and conveyance
Neighborhoods with **cooler climates** and lower temperatures


Cities with **productive** and **energy efficient** landscapes
Regions with program moved **out of the floodplain**

Local initiative meets Systematic change

Learning from Resilient by Design



The Bay Area Challenge 'Resilient by Design', an international design competition that finished this May 2018, has made a great start in analyzing these future challenges and drawing scenario's on how to deal with these for the future. To join forces and make sure that all the great ideas are kept in mind and explored further, an overarching, collective approach for resiliency in the Bay Area is needed. By sharing our Dutch visions, tools, and integrated ideas, we hope to help you to make the Bay Area Resilient for the future.

Unlock Alameda Creek: Public sediment provides a vision for sustainable supply of sediment to bay marshes and mudflats for sea level rise adaptation, reconnects migratory fish with their historic spawning grounds, and introduces a network of community spaces that reclaim the creek as a place for people, building awareness around our public sediment resources. Recognized by the Resilient by Design Jury (RbDJ) as a model for research, design, and practice around the Bay and beyond. This project recognizes the power of sediment, the creeks; the power of scale; and the power to start.

Elevate San Rafael: "Elevate San Rafael" is a new paradigm for responding to complex environmental change and simply what needs to be done: occupy higher elevations and raise the quality of life and social connection for everyone. Recognized (RbDY) for their attention drawn to immediate flood risk and impressive community engagement effort.

Collect & Connect: Resilient South City is a proposal from Hassell+ team to create more public green space and continuous public access along South San Francisco's Colma Creek, aiming to reduce the impacts of flooding, mitigate against sea-level rise vulnerability, restore native flora and fauna, and create more amenity and healthy lifestyle opportunities by connecting a continuous public corridor along the creek. Recognized (RbDJ) for their pragmatic and convincing focus on neighborhood-level interventions from the mountain to the bay.

Isles Hyper-Creek: A vision (BIG + ONE + Sherwood team) for the area where ecology and industry co-exist in harmony. A large park with a restored tidal creek system and soft shoreline shares the area with maritime functions, light manufacturing, and logistics that have formed the area's economic backbone for decades. Recognized (RbDJ) for seeing both the opportunities and the risks of impending changes in Islais Creek and for their sensitivity to the environment and the place.

People's Plan of Marin City: The Permaculture and Social Equity Team proposed a social design process to build community capacity in leading the challenges of coastal adaptation and resiliency planning. Recognized (RbDJ) for their impact in community capacity building, realigning power distributions and increasing ownership by people directly impacted by design decisions.

South Bay Sponge: The "Sponge" of the Field Operations Team is a concept for using nature and natural systems (marshes) as a primary tool for climate adaptation and resiliency in the South Bay, giving the landscapes a powerful and legible identity. Recognized (RbDJ) for their conviction to communicate and connect with the South Bay communities and stakeholders, taking a complicated issue that spans geography, jurisdiction and generations, and translating it with a playful and powerful metaphor of a South Bay sponge.

The Grand Bayway: State Route 37, a low-lying commute route that skirts the northern edge of San Pablo Bay, is both traffic-choked and increasingly flooded due to sea level rise. The project considers a new future for this highway as an elevated scenic byway, creating an iconic "front door" to a vast ecological open space previously known to few, and accessible to cyclists, runners, kayakers, campers, and fishermen. Recognized (RbDY) for the greatest ecological potential and sensitive perspective of the interactions among nature, infrastructure and people.

ouR-home: The ouR-HOME sea level rise response projects are linked to the health and financial well-being of residents that have been traditionally shut out of opportunities to improve health and family wealth. Recognized (RbDJ)for centering potent legacy work addressing disinvestment and environmental injustice. Advances the argument for the importance of modestly-scaled, but potentially highly-resonant interventions.

The Estuary Commons: To protect local neighborhoods and restore native habitats, All Bay Collective is rethinking the shoreline around San Leandro Bay with the creation of Estuary Commons, through the construction of ponds, landforms, and expanded streams. Recognized (RbDJ) for finding a way to bring culture, institutions, and the environment forward by design. Their metaphor of the Commons could be the platform needed to move this project forward and is an opportunity to bring everyone in.

Part 2:
The Dutch approach & tools for resilience

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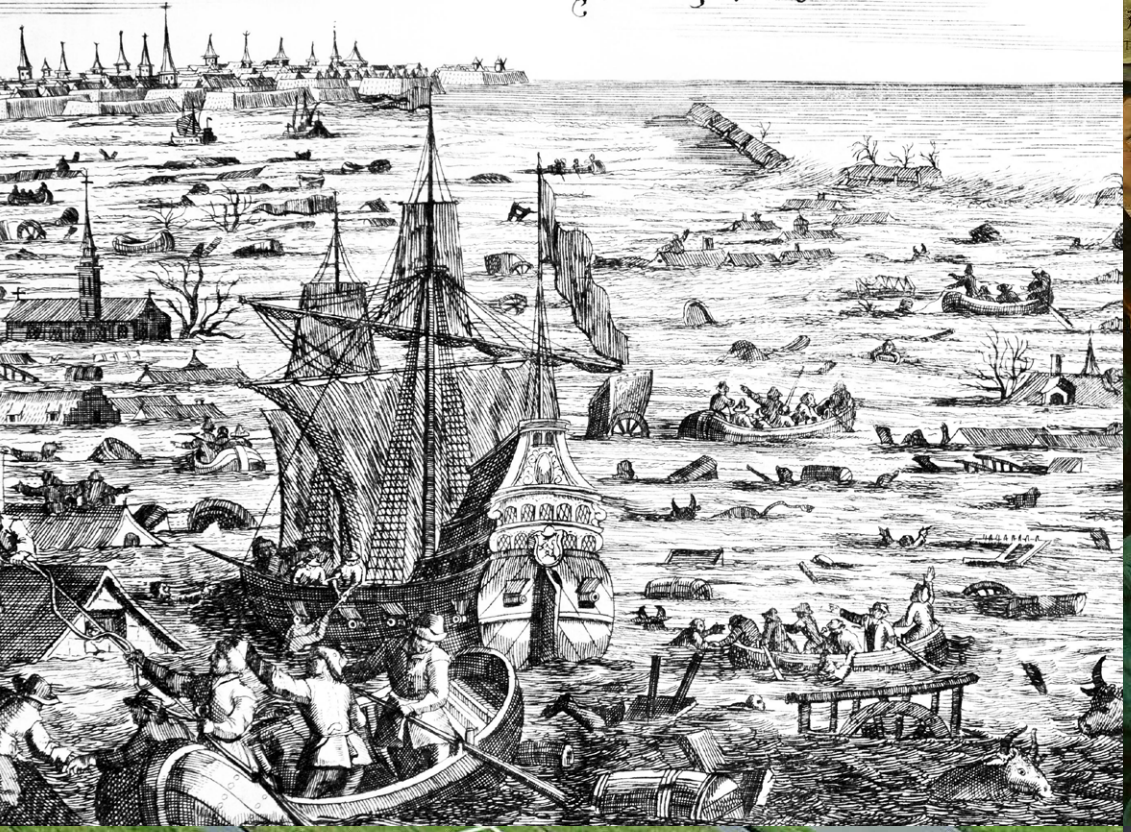
At the same time, as Dutch we realize that not all issues can be addressed at the level of the individual projects. Long-term strategies, some at the larger scale, are critical for adaptation.

Over the centuries, we have developed a broad set of social and physical tools or technologies that have helped us live with water. By collecting and presenting these tools here, we hope to inspire the Bay Area to work toward the implementation of climate adaptation projects, and to make a start with the development of long-term strategies.



How do the Netherlands deal with similar issues?

Your future is our history

Origins of the Dutch approach – the Polder Model

The Netherlands has been fighting water for centuries. Dealing with flooding events could not be solved individually. As a result, the building of dykes was carried out as a joint actions between those affected. To a large extent, this presents the origins of the Dutch polder model, characterized by consultation, consensus and compromise.

Regional water authorities (called water boards) present the first forms of functional democracy, where decisions are based on consensus. Nowadays, the regional water authority organization still holds an independent position in the democratic system in the Netherlands. Because water-related tasks are allocated to regional water authorities, they are not subject to a general political balance of interests. The importance of keeping dry feet and of having enough usable water is of existential importance for the Netherlands, so it is kept separate from the political context. The budget for water governance in the Netherlands is, therefore, not balanced against that of e.g. education, the health care system or defence.

Scale-up & merging of authorities

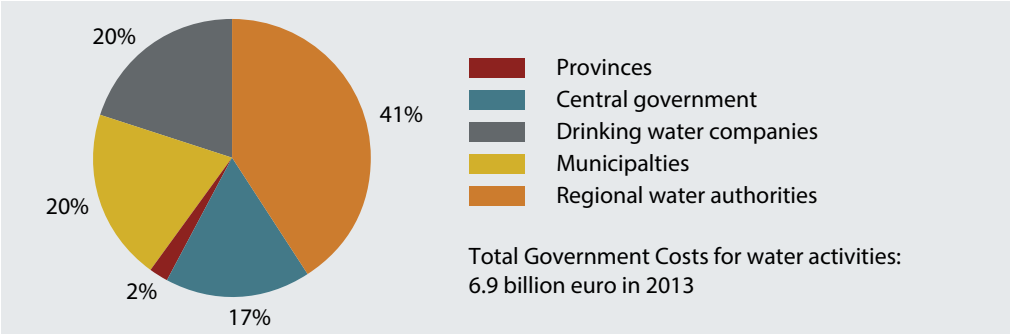
The regional water authorities have undergone an enormous scale increases over the past 50 years. Of the approximately 2,650 water authorities that existed in 1950, there are now just 23 remaining. There are three main reasons for this merging process.

Firstly, the flood of 1 February 1953, during which 1,836 people lost their lives and which caused enormous financial damage. Secondly, from 1970 onward the task of water quality management, including wastewater treatment, was allocated to the water authorities. After all, the task of building and managing costly sewage treatment plants and pressure pipelines calls for a firm administrative and financial basis of support.

Thirdly, the government policy aimed at achieving integrated water management, where the various task components such as surface water and groundwater in both a quantitative and a qualitative sense, should be regarded in conjunction with each other and therefore preferably as a single organization (the 'all-in regional water authorities'). This was realized in 2005. Also the number of drinking water companies reduced, because of efficiency (costs) and quality considerations, from 198 in 1952 to 10 companies today.

Costs

Water management in the Netherlands is almost entirely in the hands of the government. All kinds of water-related tasks come under public law and are executed by the central government, provinces, municipalities and regional water authorities. They are financed by the State's general funds or from the revenues generated by various decentralized taxes. Drinking water supplies are the only exception to this. Drinking water supplies are taken care of by the water companies and the costs are recovered from the citizens by means of invoices under private law. In practice, however, drinking water supplies are largely controlled by the national government. This regulatory positioning is laid down explicitly in the Drinking Water Act. The total government expenditure for water-related activities, including those of the water companies, was 6.9 billion euro in 2013.



The Dutch approach

1. There is always the beckoning (economic) perspective for all stakeholders that is jointly identified and made explicit.
2. Interests, themes and desired developments are clearly visualized.
3. There is insight and understanding for each other's point of view.
4. There is no lack of commitment and understanding that a long-term relationship is necessary to realize the perspective.
5. An appropriate institutional framework is helpful, but trust and ownership in the process are crucial for common and organic development.
6. Data tools offer common basis for dialogue. "Without the facts, you are an opinion".
7. Serious gaming helps define and understand various perspectives and expected outcomes.

Your future is our history

San Francisco Bay area faces increasing complexity and uncertainty in decision-making to cope with global change, including social changes and extreme weather events. It is important to jointly envision the future and start talking about it differently. There are certain aspects in the Dutch Polder Model for water management that could inspire the Bay area to address its needs. For instance the integrated approach to water issues in which all aspects of water management are incorporated, the co-operative approach where decision-making is based on consensus and the independent financial position separate from the political context.

Tools

Water management

- Water Modeling
- Monitoring: you cannot manage what you don't know
- The Delta Programme and Adaptive Management
- Stress Test and Drought
- Nature based solutions
- Flood risk management

Sustainable mobility

- Cycling policy and designing active streets
- Planning for integrated transit systems
- Transit Orientated Development and parking
- Mobility hubs

Area Development

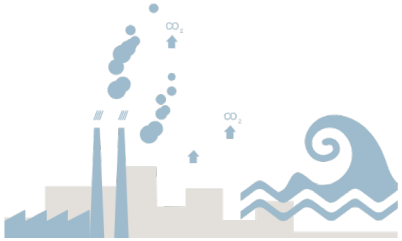
- Transferable Development Rights
- Urban Re-allotment
- Developing Apart Together

Inclusive Design

- Floating buildings and circularity
- Participatory design tools
- Strategic visions & scenario visualization
- Compact Quality tools
- Design quality guidelines

How can the Dutch approach help to increase resilience?

Our tools for resilience



CURRENT CITIES

CLIMATE READY CITIES

The following principles for adaptive growth and planning can help to increase the resilience capacity of the Bay area and its people:

Take a system's approach

Understanding the system as a whole, including physical, social and economic aspects and their linkages. Understanding your system is at the basis of everything, since you can't manage what you don't know.

Design for 'remain functioning'

Designing in a manner that ensures critical infrastructure remains in service and consequences of failure are manageable even after extreme events.

Invest in enhancing physical, social and economic resilience

Increase the recovery capacity of society to deal with global change, including extreme events.

Create long-term adaptivity

Enhance learning and build the capacity to adapt and the flexibility to do things differently to deal with change.

Types of tools for resiliency

How do we translate these principles into the reality of existing urban conditions, creating a resilient future for the people and systems within them? Apart from the polder model, a constant and serious dialogue of all stakeholders, we apply a diversity of tools during the planning, realization and after care/monitoring stages of urban projects. We believe that some of these tools can be relevant for the processes and systems in the Bay Area, supporting an incremental resilience of the whole region.

Water management tools

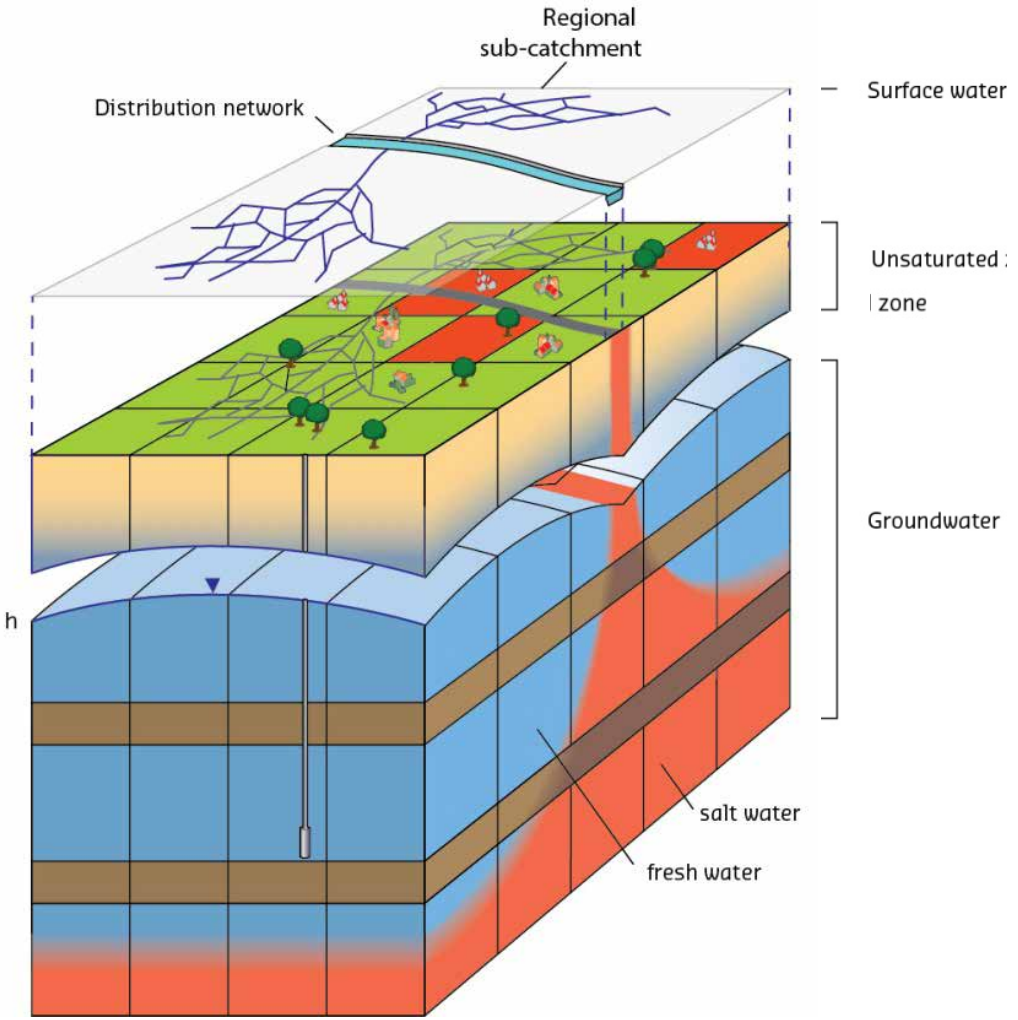
Water management tools have helped us understand the interplay between stormwater, drought, groundwater, drinking water, waste water and coastal water, including future effects of subsidence and sea level rise. This has resulted in management strategies that find a balance between safety, ecology and economic development (in particular agriculture) by working at all scales simultaneously, and by linking governance models to physical measures at the appropriate scale. For the Bay Area, such an approach integrating all water system aspects should result in a better systems level understanding of the hydrology of the entire Bay and delta, and a governance structure that would make it possible to intervene at the same scale.

Tools for water management:
Water modeling

The Netherlands Hydrological Instrument – An operational, multi-scale, multi-model system for consensus-based, integrated water management and policy analysis.
Water management in the Netherlands applies to a dense network of surface waters for discharge, storage and distribution, serving highly valuable land-use. National and regional water authorities develop long-term plans for sustainable water use and safety under changing climate conditions. The decisions about investments on adaptive measures are based on analysis supported by the Netherlands Hydrological Instrument NHI based on the best available data and state-of-the-art technology and developed through collaboration between national research institutes. The NHI consists of various physical (numerical) models at appropriate temporal and spatial scales for all parts of the water system. Intelligent connectors provide transfer between different scales and fast computation, by coupling model codes at a deep level in software. A workflow and version management system guarantees consistency in the data, software, computations and results. The NHI is freely available to hydrologists via an open web interface that enables exchange of all data and tools. This comprehensive instrument is the outcome of 35 years of development and collaboration between water-related governmental and private organizations. Given the support of the water authorities in the Netherlands, it is envisioned that the NHI will become the hydrological instrument and toolbox (tools and data) for model-based solutions to surface water and groundwater issues at national, regional and local scale.

NHI consists of five hydrological models. The surface water domain is classified at three levels of operation: at national level few large canals, rivers and lakes with large weirs are available to manage the major transport and storage capacity both during water surplus and shortage. The major resources of water are the river Rhine and the precipitation (850 mm/y) from the maritime climate. At regional level, a large number of intermediate surface water bodies provide regional water distribution. Along the coast in the west and north of the country subcatchments consist of polders (reclaimed lakes) with abrupt changes of several meters in elevation at short distances. In the rest of the country, most of the brooks and streams have been canalized and seepage zones have been drained to improve the economic value of the land. At local scale, numerous dense drainage pipe systems and ditches operate as the major interaction with the groundwater domain. The major groundwater domain consists of Pleistocene sands and is overlain by fluvial and marine Holocene peat and clay deposits in the lower-lying areas and by glacial and Aeolian sands in the higher areas. In a wide zone (50 km) along the entire west and north coast seawater intrusion in the past has caused a wide variation in the salt concentration of groundwater. The vegetation on top of the groundwater system merely consists of crops and pasture with forest mainly in the higher areas and designated nature reserves mainly in the lower areas. Local relief affects the presence and amount of infiltration and seepage which, in turn, results in differences in the water quality in the root zone.

The water domains covered by the five hydrological models in NHI.



Water modeling:
Impact on the Bay Area

Water Modeling

The San Francisco Bay-Delta system is complex in its physical and environmental dynamics. Modeling tools that integrate hydrodynamics and water quality dynamics are essential to unravel the governing processes on various spatial and temporal scales and assess potential developments due to climate change and adapting management strategies. There is a need for open access, publicly available, integrated modeling platforms to facilitate and enhance interdisciplinary and interagency scientific communication, collaboration, and understanding.

This website provides a platform for availability and continuous development of a process-based, hydrodynamic surface water flow model applying the Deltares Delft3D FM (flexible mesh) software describing the San Francisco Bay-Delta system. The domain covers an area from Point Reyes up to the tidal limits near Sacramento and Vernalis. A high resolution mesh ultimately allows for detailed computations of

- flow (including salinity and temperature)
- sediment transport (sand and mud transport, suspended sediment concentration, turbidity, morphodynamics)
- water quality (including turbidity, phytoplankton, nutrients, and contaminants) and
- eco-systems (habitat indicators)

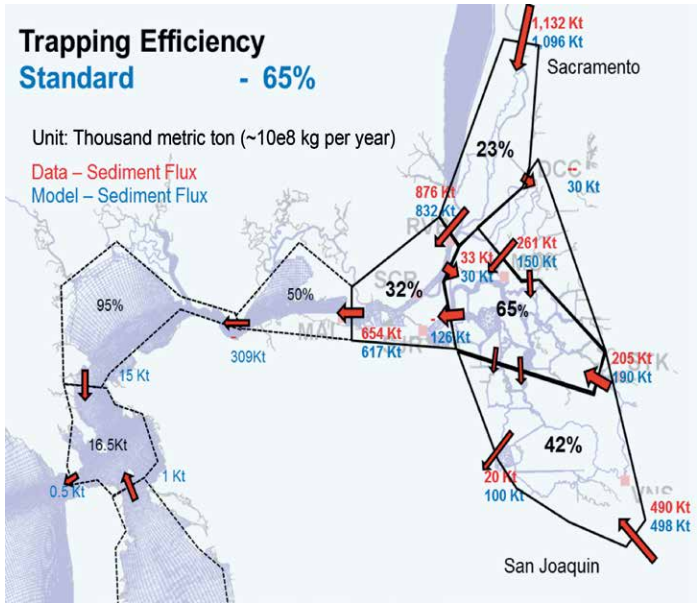
A Delft3D curvilinear grid model for the Bay Delta is available at http://walrus.wr.usgs.gov/coastal_processes/sfbaycoastalsys/SFBay_model/.

Bay Delta Community model by Deltares, developed in collaboration with USGS, SFEI, Berkeley etc.

Advice: include ground water modeling in Delta Community model and local catchment modeling

San Francisco Bay Area Community model (Preliminary results)

Sacramento River inflow	Remains fairly constant in future compared to current conditions with high variability over the years
Sediments	Decreasing supply from the major river (Sacramento and San Joaquin) leading to relatively more supply from local tributaries. drowning of mudflats and salt marshes under sea level rise
Salinity	More landward intrusion due to higher mean sea level
Temperature	Warmer water surface temperatures mainly in Delta by local heating and warmer river water
Water quality	Limited sewerage water treatment and industry/agriculture outfall continue to provide nutrients/contaminants to Bay-Delta system
Ecology	Less turbidity due to larger water depth (sea level rise) and decaying sediment supply. This leads to more phytoplankton and algae blooms in nutrient rich Bay-Delta system

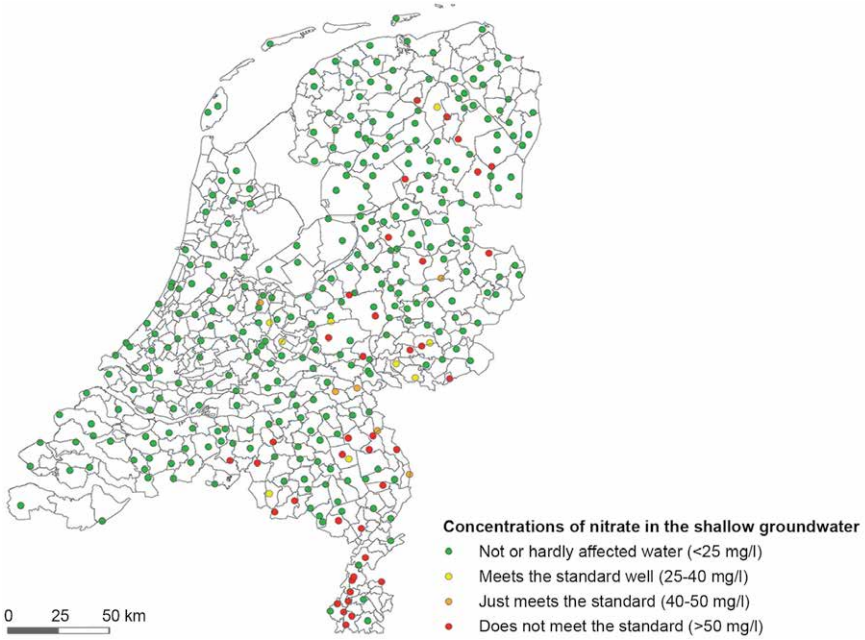


Sediment fluxes are strongly depending on supply Sacramento River. South Bay is rich in sediments, but these are mostly generated during the Gold Rush. In future due to lower supply from Sacramento catchment and because of rising water levels, sediment in the South Bay will be declining. Therefore mudflats and marshland will drown during rising sea level (less erosion, gradually process). A related risk is algae growth because of increasing transparency (less sediments, increased water levels) and the already plenty available nutrients.

Tools for water management:
Monitoring

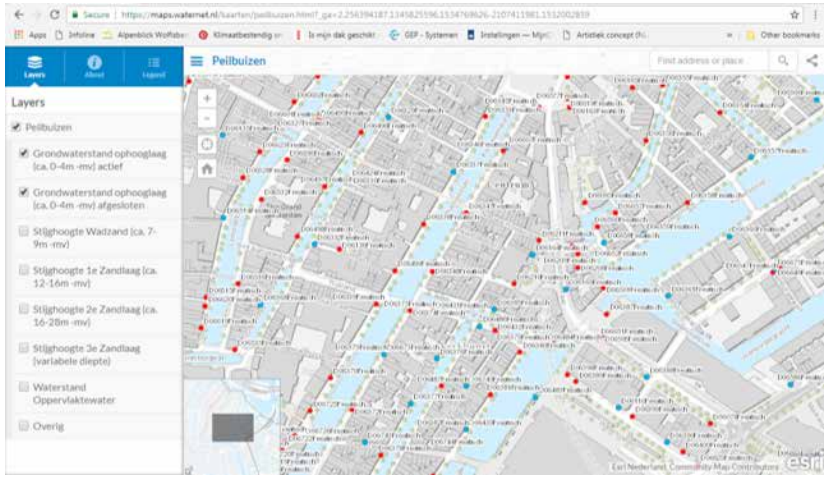
Monitoring: you cannot manage what you don't know

In The Netherlands water is monitored by different authorities at different scales. The 12 provinces own their regional (primary) groundwater network with shallow and deep observation screens. This network is designed to construct groundwater contour maps and is periodically optimized using statistics. The time series are mostly more than 40 years long. Nature organizations, water boards and cities own their more detailed monitoring networks. The provinces and national government together also own a groundwater quality network. These observation wells are constructed according one protocol, and sampled every year. Nearly all monitoring data are stored in one national public available database: DINO*loket* (www.dinoloket.nl). This database also collects public accessible (hydro-)geological borehole data which are the basis of a 3D (hydro-)geological model.
Surface water (quantity, quality and ecology) monitoring networks are maintained by Rijkswaterstaat (national level) and water boards (regional level).

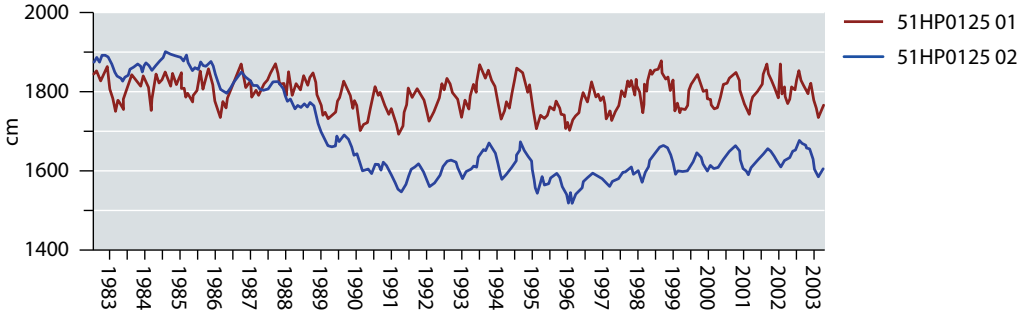


Groundwater quality network of The Netherlands. Locations based on groundwater situation, soil type and land use

Examples in the Netherlands



Public website of Amsterdam urban groundwater network. Data and time series are direct available (https://www.waternet.nl/en/our-water/grondwater/)



Example of a groundwater time series with a shallow phreatic groundwater filter (01) and deep filter (02). The shallow filter shows seaonal fluctuations and the deep filter a decreasing hydraulic head (groundwater pressure) caused by groundwater pumping. Because of a very impermeable clay in between the impact on phreatic groundwater is small, but nature areas depending on groundwater discharge became vulnerable.

Monitoring:
Impact on the Bay Area

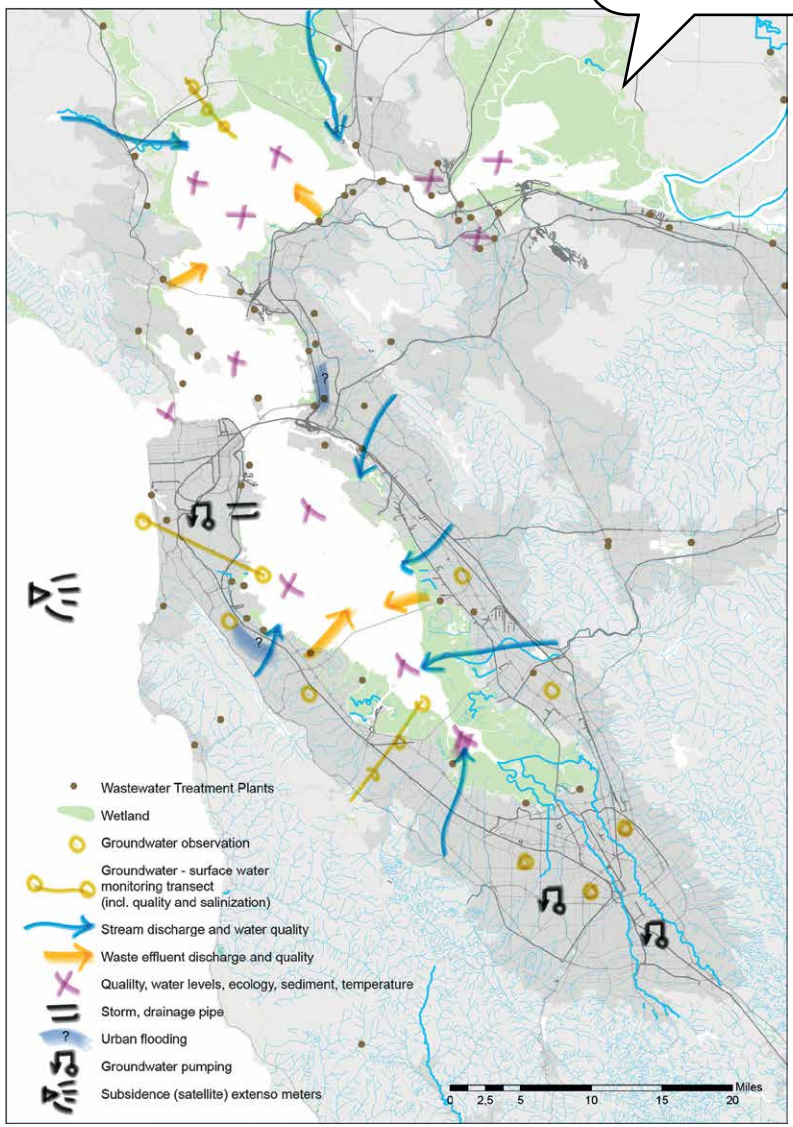
Advice: work together to align and improve monitoring and creat one "water and subsurface"network

Towards one integrated and public accessible monitoring network for all water and subsurface data

In The San Francisco Bay area are maintained several monitoring networks by different organizations, e.g. water quality in some Nature reserves by the U.S. Natural Park services, water quality and sediment of the Bay Area by SFEI, water levels of the Bat area by the Army Corps of Engineers, groundwater levels at random locations by the USGS and many more. Monitoring efforts could be improved after a discussion about needed monitoring objectives, followed by evaluating the existing networks. It's clear that monitoring need to be improved in this time of Climate Change and Sea Level. Therefore all organizations should work together and design one 'water and subsurface' network, strengthen each other and in agreement with the objectives. In the following table all monitoring topics are summarized. Of course, an optimized integral monitoring can be partly based on existing sites.
Eutrophication of the Bay Area example: To understand this process Bay water need to be sampled at different locations and depths (condition monitoring). To understand this condition several other impacts need to be monitored at the same time: the amount and quality of waste water discharge into the Bay, the amount and quality of stream discharges, the influence of Sacramento River, the temperature of the Bay, and the interaction with Bay dredge.

Rain, evaporation, groundwater recharge	• E.g. Lysimeter network (monitoring groundwater recharge)
Groundwater	• Design Bay area wide groundwater network for: – Groundwater levels and hydraulic heads – Groundwater quality – Fresh-salt gradients
Rivers, streams	• Design Bay area wide network: – Discharge quantities in time – Quality – Aquatic ecology
Storm drainage pipes at Bay shoreline	• Map and categorize outlets: – Monitor quantity and quality of selection
Urban flooding (including transport lines)	• Where, how much and when (camera's)
Bay water	• Optimize level, quality, salinity, temperature, water depth and sediments monitoring sites if needed. Making use of Bay model
	• Monitor ecological and morphological state of marshes and mudflats
Waste water treatment plants	• Map locations WWTP's and pipe outlets. Monitor: – Discharge , quality and temperature
Groundwater pumping	• Map all locations and categorize: drinking water, industrial, irrigation, infrastructure (BART tunnels, basements, parking garages)
	– Determine discharge quantity. quality and outlet
Subsidence	• Using Lidar or satellite images and extensometers

All data in one web based database. Clear visualizations of the meaning of monitoring results. Agreements about consequences of monitoring results.



Tools for water management:

The Delta Programme and Adaptive management

The Delta programme and the delta Commissioner

The government intends to protect the Netherlands against high water and secure a sufficient supply of freshwater now and in the future. In addition, the government seeks to climate-proof our country and improve its water resilience. We are making plans to this end in the Delta Programme, in collaboration with various authorities and other organisations. The plans are being drawn up under the direction of the government commissioner for the Delta Programme: the Delta Commissioner.

The aim is to ensure that our flood risk management, freshwater supply, and spatial planning will be climate-proof and water-resilient by 2050, so that our country will continue to be able to cope with the increasing weather extremes. This time around we will try and prevent a disaster, rather than devise measures on the aftermath. The first Delta Commissioner, installed on 1 February 2010, is responsible for drawing up, updating, and (commissioning) the implementation of the Delta Programme, including the financial consequences, on behalf of the Government. The Delta Comissioner is politically independent and his work and results are evaluated by Dutch parliament.

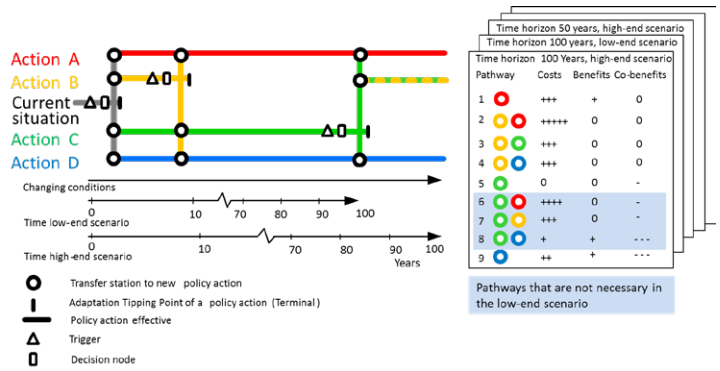
Delta Programme Commissioner Wim Kuijken.

For that reason, the government has adopted a new approach to working on the delta, in concert with other organisations, focusing on three areas:

- New flood protection standards have been implemented: these are not only linked to the probability of flooding, but also to the impact of a flood (risk-based approach).The stringency of the standards is determined by the scope of the potential impact.
- The availability of freshwater for agriculture, industry and Nature will become more predictable;
- Spatial planning will become more climate-proof and water-resilient.

Adaptive management and planning

Looking far ahead means factoring in uncertainties in climate change and socio-economic developments. The national government ensures that the Netherlands is prepared for various future scenarios. We choose strategies and measures that enable us to come up with a flexible response to new measurements taken and new insights into the climate, for example. We are doing what we need to do at this time. Supplementary measures are ready, should we need them in the future. We call this approach adaptive management and planning. All stakeholders view this approach as a pragmatic solution for dealing with developments that are uncertain. Adaptive management and planning can make use of adaptive pathways that explicitly include decision making over time and sequences of decisions under uncertainty. An adaptation pathways map shows different possible sequences of decisions and a scorecard to evaluate those decisions.



Example of adaptation pathways map. Haasnoot, M., J. Kwakkel, W. Walker, J. Maat. Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. Global Environmental Change. 2013. 485-498.

The Delta Programme and Adaptive management:

Impact on the Bay Area

Examples in the Netherlands: Zuiderzee

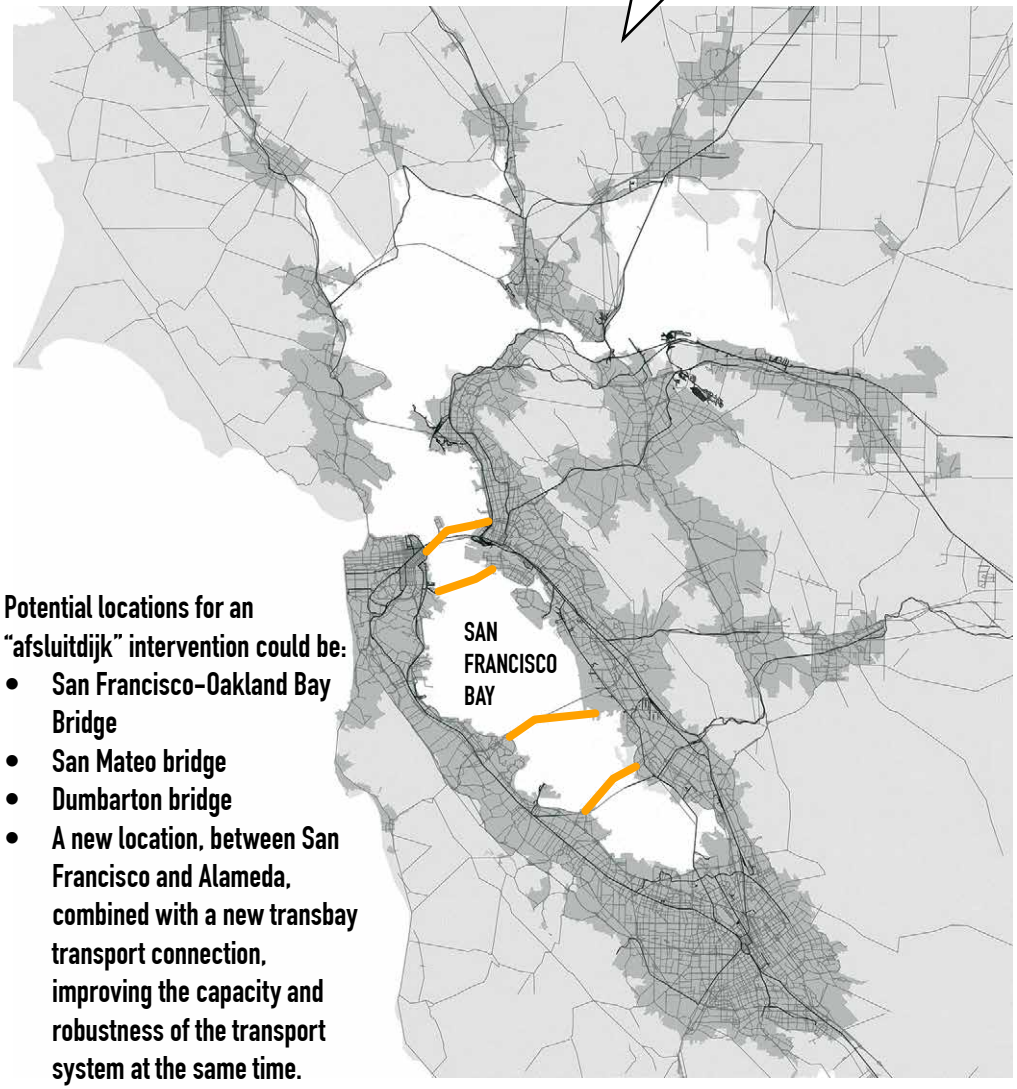
For centuries the Zuiderzee caused severe flooding damages during Northern storms. Large areas along the coastline, including Amsterdam were flooded frequently. The surface area and morphology of the Zuiderzee have many similarities with the South Bay area. The Zuiderzee occupies 2278 square miles, South Bay 1600 square miles. Both bottom depths are shallow, approx. 6-9 feet deep and both are or were surrounded by marshes (bulrushes).

At last the storm of 1916 forced the Government to produce a water defense strategy. This plan was supported by the (national) Zuiderzee Law (1918), guaranteeing safety, but at the same time creating agricultural land (on account of the large food shortages during the Great War, 1914-1918). Fourteen years after the installation of the Zuiderzee Law the bay was closed by the Afsluitdijk (1932): the salt-brackish bay was transformed into a fresh water lake (Ijsselmeer) and water level was fully controlled. This lake became also a very important fresh water reservoir for agriculture and water management (including subsidence) in the northern regions.

In 1942 the first new polder was finished (North East polder). The lessons learned during and after construction were implemented in the new (southern) Flevo polders (1955-1968), e.g. the construction of marginal lakes between new and old land to reduce damage in former shoreline villages, caused by decreased groundwater levels. During the seventies also urban development (Lelystad and Almere) became important. In 1975 the construction of the Houtribdijk was finished. This was meant to be the east levee of the Markerwaard polder. But after long discussions the construction was cancelled because of ecological and water management considerations (keeping it a reservoir for droughts). The Houtribdijk became an important transport connection and the Markermeer nowadays is an important recreation area. In 2017 started the Markerwadden project: nature based solution creating a series of islands and swamps to improve water quality (filtering fine sediment particles) and provide space for ecology and recreation.

Impact of regional applicability

Is the "Afsluitdijk" approach a solution for controlling rising water levels in the South Bay?



Potential locations for an "afsluitdijk" intervention could be:

- **San Francisco-Oakland Bay Bridge**
- **San Mateo bridge**
- **Dumbarton bridge**
- **A new location, between San Francisco and Alameda, combined with a new transbay transport connection, improving the capacity and robustness of the transport system at the same time.**

Tools for water management:
Stress Test and Drought

The new Dutch climate 'stress test'

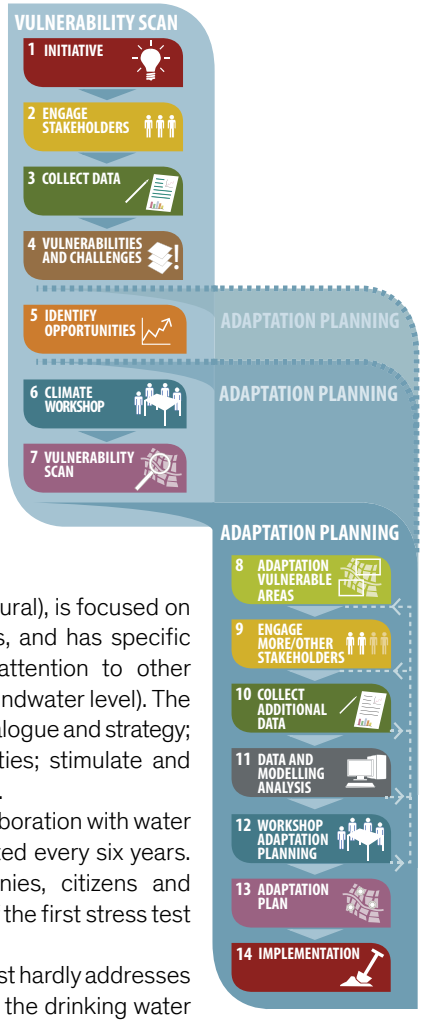
The (Dutch) stress test is intended to determine the urban vulnerability for weather extremes. The results form the basis for spatial adaptation. Key questions for the stress test are: How capable are we to prevent climate damage? And how capable are we in minimizing the damage in case our protection systems are overloaded by extreme weather and exposure is unavoidable?

Adaptation measures are meant to achieve this. Sustainable economic strength, social and competitive attractiveness of an urban area often is accepted reasons for starting stress testing. But other challenges such as intensified investments per hectare, increased mobility, new technologies, public health concerns or increasing public expectation of a perfectly functioning environment are valid arguments for stress testing and adaptation too. Land subsidence, a consequence of drought and low groundwater levels, aggravates our vulnerability to flooding and is therefore essentially included in our vulnerability scan and adaptation planning.

The test has a number of features: it is spatial (urban and rural), is focused on vulnerability to flooding, heat stress, droughts and floods, and has specific attention to vital and vulnerable functions and pays attention to other developments that increase vulnerability (subsidence, groundwater level). The test formulates seven challenges: the vulnerability; a risk dialogue and strategy; an implementation agenda; use matchmaking opportunities; stimulate and facilitate; regulating and securing; act in case of calamities.

Municipalities have a role to play in implementation, in collaboration with water boards and provinces. The stress tests need to be executed every six years. Subsequently, they must enter dialogues with companies, citizens and organisations. The next step is the execution. The results of the first stress test are to be delivered in 2019.

In contrast with the Californian situation, the Dutch stress test hardly addresses drinking water security. Even in 2018, the driest year ever, the drinking water resources (groundwater, surface water) were not in danger. The vulnerability of the water supply systems in California is however a logical part of a Californian stress test.

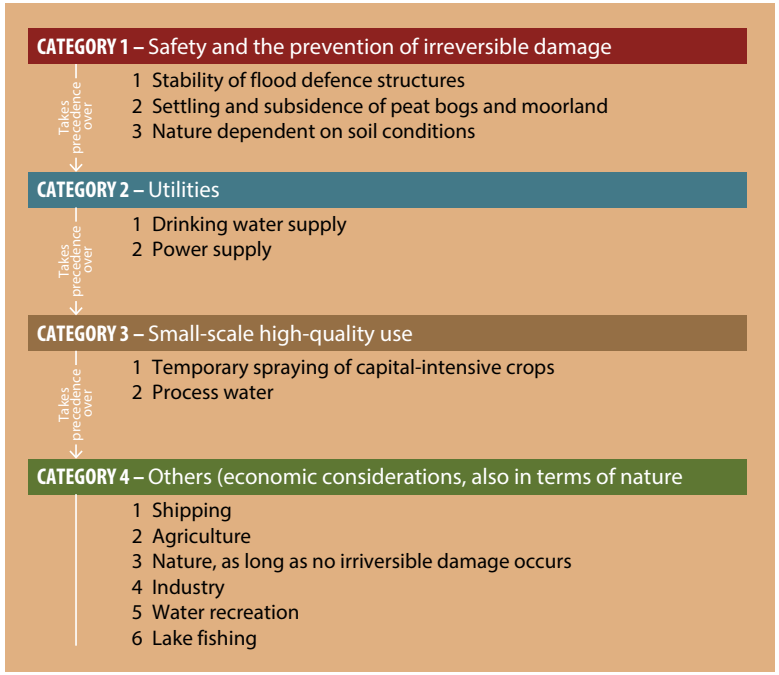


Urban climate vulnerability stress test

Drought management: de Droogte Ladder

How do the Dutch respond to periods of drought and water shortages?

Periods of drought can sometimes last so long that it is no longer possible to serve every designated use. This forces us to choose: who or what takes priority in the distribution of scarce supplies of river water? This choice is not made all over again each time but criteria are laid down in a 'sequence of priorities'. These priorities were drawn up in response to the exceptional drought of 1976, and updated after the summer of 2003 when drought was almost as intense. Unfortunately for shipping and the other sectors in category 4 the water level in rivers, canals and harbors is the least of our concerns when water is in short supply. If needs be, farmers and horticulturalists who cultivate capital-intensive crops and factories using process water (category 3) are also ignored, so as to allocate only water to the production of drinking water and to power stations (category 2). Ultimately, all that remains are the interests of the first category: safety and the prevention of irreversible damage.



The sequence of priorities

Stress Test and Drought:
Impact on the Bay Area

Drought and the Californian 'stress test'

The last years (2012-2017) California has been dealing with the effects of unprecedented drought. Drought is monitored by NOAA, the USDA and the National Drought Mitigation Center, releasing drought maps each week, indexing several factors like precipitation, groundwater storage and river levels. Nowadays, the concerns of the soil moisture situation are growing, not only in relation to agriculture, but also to fire risks.

Until now the Californian drought discussions and measures are focussed on drinking water availability. The extreme drought periods in the last decennium made (temporally) restrictions of the use of drinking water necessary. Drought in the Bay Area is related to precipitation deficits, but also to (low) reduced snow fall in the Sierra Nevada Mountains (2015 worst snowpack in 500 years). Therefore, the State Water Board released a water supply 'stress test'. Water suppliers have to demonstrate whether they have adequate supplies to withstand three additional dry years. Water suppliers that pass their 'stress test' will not face state-mandated conservation standards, but are expected to keep conserving water to build long-term drought resilience. Drought regulations also keeps bans in place for specific water uses, like watering down a sidewalk with a hose instead of a broom, overwatering landscape to the point where water is running off the lawn, prohibitions against lawn irrigation right after rain and requirements that hotels post signs telling guests they can choose not to have towels and sheets washed every day.

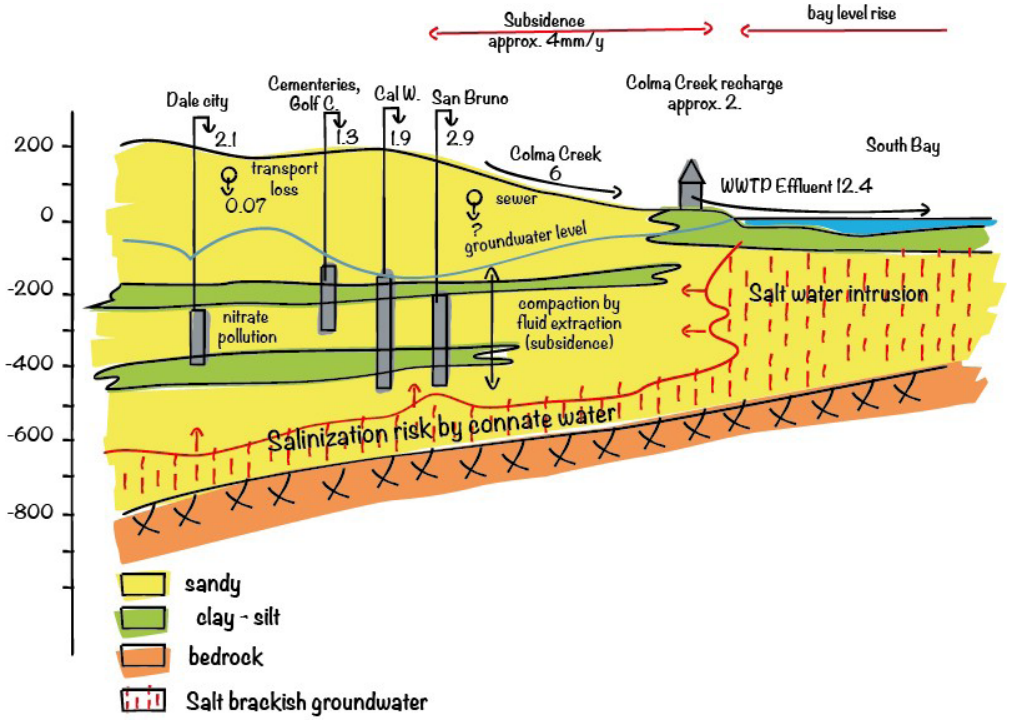
Climate Change, drought and future water management

According to the California Department of Water Resources (DWR) the total water use in the San Francisco Bay region in 2010 was about 1.2 million acre-feet. Of that amount 90% was used in urban areas for residential, commercial, industrial and institutional purposes and 9% for agricultural irrigation. Urban and residential use (per person per day) is under normal conditions approx. 150-90 gallons respectively, but was fallen during the drought period to record lows of 119 and 72 gallons (per person per day). It's believed that improvements are still possible. For example, water use in The Netherlands is 34 gallon p.p.p.d, in SE Queensland (Australia) 45 gallon p.p.p.d and in Israel less than 36 gallons (Source: Drought and Equity in the S.F. Bay Area, Pacific Institute 2016). The state of infrastructure and related water loss is another concern. It is clear that now and in the future structural improvements are necessary by further reduction of drinking water use and by reducing water loss. It is estimated that the water use per person can be halved.

One of the largest resources of fresh water in the Bay Area is treated waste water treatment effluent (WWTE), of which only a very small amount is used nowadays for irrigating golf courses. A large-scale re-use program of this WWTE water (of course after improved treatment) not only reduces the general drought vulnerability, but also helps improve the surface water quality in the Bay Area, now and in the future. Doing so, also ground water pumping for irrigation of cemeteries and golf courses can be stopped and groundwater bodies can recover and be used for emergency periods as a strategic resource, so that salinization and subsidence can be reduced.

Improvement of the flood defence system can also be combined with drought management. New levees can be designed in a way that storm water is being collected in reservoirs (harvesting storm drainage extremes).

A stress test of the Bay Area water system including the small water cycle of water supply and wastewater treatment could not only identify its vulnerabilities and interdependencies; it would also lead to identification of alternative opportunities and options and help design strategies to implement new, more circular solutions to strengthen the robustness of the system as a whole.

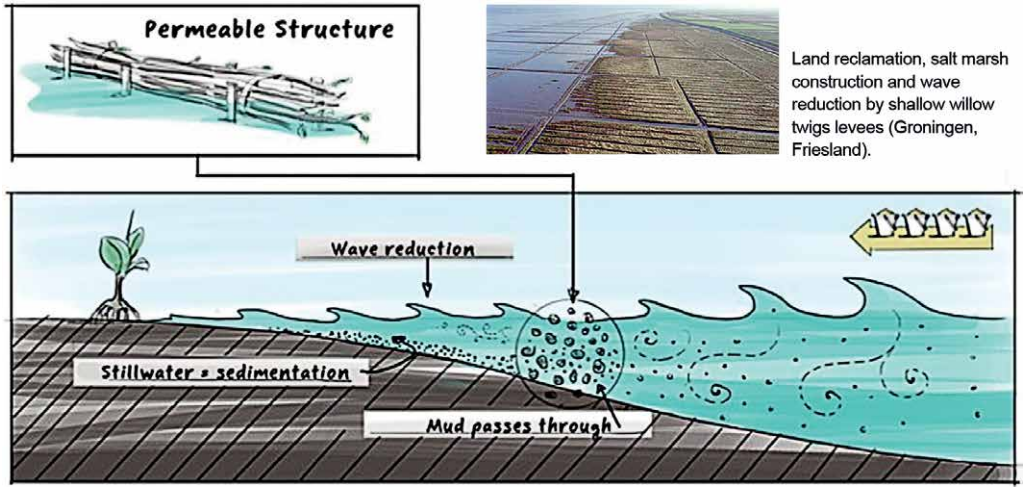


Groundwater situation near South San Francisco – Groundwater pumping (million m^3/y) exceeds recharge: therefore groundwater levels dropped tens of feets, activating salt water intrusion processes and likely also subsidence. Despite the lack of fresh water, 12.4 million m^3/y of (fresh) wastewater treatment effluent is discharged into the Bay, and is therefore also a polluting factor.

Nature based solutions. Soft interventions first

Implementation of nature-based interventions is on the rise. Nature now often has new functional labels added, parks for 'water retention', mangroves 'for coastal resilience' and oyster reefs as 'living shorelines'. There is a lot to say in support of nature-based solutions. They are generally low-carbon, sustainable and environmentally friendly and they deliver additional co-benefits. (https://www.deltares.nl/ en/blog/nature-based-solutions-know/).

Towards commonly accepted guidelines – A brief guidance document was drafted in April 2017 by more than 70 experts of 25 organizations, amongst which The World Bank Group, the Global Facility for Disaster Risk Reduction (GFDRR), United Nations Development Program, Deltares and Ecoshape. The guidance document starts with five principles. The first principle recommends execution of a system-scale assessment taking into account environmental, socio-economic and institutional conditions for optimal design of interventions. The second principle advocates that a risk assessment should be executed to define the basis for comparison of different measures and their combinations. This also opens the possibility for use of combinations of green and grey measures. Third, the use of existing knowledge on conservations, management and restoration of ecosystems is indorsed. Implementation of nature-based solutions can make use more consistently of this field of knowledge.



Land reclamation, salt marsh construction and wave reduction by shallow willow twigs levees (Groningen, Friesland).

Clay (dredge) ripening project

By making use of 'low impact' restoration methods that focus on restoration of abiotic conditions more impact and larger spatial scales can be targeted. By doing this project failure can be reduced which will result in more cost effective implementation. The fourth principle stresses that for proper design of nature-based interventions they should be held against similar criteria as conventional engineering measures in. Only by doing this, proper performance criteria can be defined for nature-based measures. Fifth and finally it is stated that adaptive management will facilitate involvement after construction and project adjustment if performance criteria are not met. By doing this the guidance is only a first step in starting our collaborative learning process on nature-based solutions.

Examples in the Netherlands

Clay Ripening Pilot Project – Excessive levels of sediment in the Eems-Dollard area are having a negative impact on water quality and biodiversity. Large amounts of sediment accumulate in ports, making regular dredging necessary. On the other hand, clay soil is needed in the area to strengthen dikes and to raise farmland. Collecting sediment from the Eems Dollard and converting it into clay soil creates a win-win situation: the water quality improves and there is more clay soil for reinforcing dikes and raising farmland. There are plans for more dike upgrade operations in the future on the Eems-Dollard coast, and clay soil will be needed there, too. At the moment a pilot project started.

Nature based solutions:

Impact on the Bay Area

"Working with Nature" concepts

Applied in the Netherlands	Opportunities in the San Francisco Bay area
1. **Room for the River** The goal of the Dutch Room for the River Program is to be able to manage (reduce) higher water levels. At more than 30 locations, measures are taken to give the river space to flood safely. Moreover, the measures are designed in such a way that they improve the quality of the immediate surroundings.	This concept could be applied in many of the local or regional streams (like Colma Creek in South San Francisco, Alameda Creek) to reduce urban flood risks. Widening the rivers will reduce water levels during peak storms and improve water quality, nature and recreation opportunities.
2. **The Zand Motor (Sand Engine)** A sandbar-shaped peninsula was created by humans; the surface is about 1 km^2. This sand moves over the years by the action of waves, wind and currents along the coast. To protect the West of the Netherlands against the sea, the beaches along the coast are artificially replenished every five years, and it is expected that the sand engine will make replenishment unnecessary for the next 20 years. This method is expected to be more cost effective and also helps nature by reducing the repeated disruption caused by replenishment.	It's very thinkable that the Bay area will suffer sediment deficits in the future because of reduced river supply, in combination with rising Bay water levels. Therefore, Zand Motor type like solutions could help protect existing mudflat or marsh areas in future. It needs to be studied where sediment can be collected. Perhaps re-use of dredge, perhaps mining upstream or in the Ocean or using surplus sediments from construction sites.
3. **Second berm concept** Constructing a second berm at the front side or at the back side of existing levees to create additional safety, water storage, nature opportunities and other functions.	A second berm can be an eco-friendly design to improve safety along the Bay shores and at the same time create multiple benefits, like the creation of fresh water reservoirs (harvesting local stream peak flows, available for drought periods), marshes, and recreation.
4. **The Marker Wadden** Constructing islands, marshes and mud flats from the sediments that have accumulated in the (Marker) lake in recent decades. These new constructed islands will form a unique ecosystem that will boost biodiversity , improve water quality and at the same time benefit recreation	Constructing artificial islands at appropriate locations could help manage sediment processes, reduce wave energy and at the same time benefit ecology and recreation.
5. **Green urban infrastructure** Reducing storm drainage and increase groundwater recharge using rain gardens (water storage), permeable pavement etc. Stimulate cooling using green roofs.	To fight urban flooding, drought and heat at the same time multiple green infrastructure activities need to be designed at every scale. Starting at the scale of private properties, e.g.by stopping storm drainage into the public area, store and re-use for sprinkling.
6. **Water quality treatment by wetlands** Using small urban or larger wetlands.	Create treatment wetlands around the outlets of Waste Water Treatment Plants, streams and storm drains to improve water quality.
7. **Wave energy reduction by willow woodlands** This solution focuses on the creation of woodlands that dissipate wave energy in the intertidal zone and influence erosion and sedimentation. It's development requires integration of ecological and engineering knowledge.	Restore marshlands, create new marshlands in combination with (aquatic) woodlands taking into account future Bay levels and sediment availability.
8. **Re-use of dredge material**	Transform dredge into construction material (clay).
9. **Creating or restoring wave reducing reefs**	E.g. by creation of oyster reefs.

Tools for water management:

Nature based solutions: examples

The Dutch Sand Engine experiment in dynamic coastline management is an artificial sand beach designed to erode. Sand pulled away from the 126 hectare peninsula by wave, wind and currents spreads along the Delfland Coast of the Nethertands, naturally nourishing a shoreline that has suffered rapid erosion.

Recent construction of Markerwadden in the former Zuiderzee near Amsterdam: creating nature, supporting recreation and improving water quality. an example of a second berm concept.

At the Koopmanspolder along the IJsselmeer shore an inland shore is created with multiple benefits: safety, ecology, water storage and water quality improvement. This type of solutions could be applied along the Bay shoreline.

Tools for water management:

Flood Risk Management

Programmes

National Assessment Report (LRT) primary flood defences (1996-2006)

Flood Protection Programme 2

2005 2010 2015 2020

Budget

2.7 Billiion

87 Projects

completed *ongoing projects*

Objectives
- Reinforcing 362 km of dykes, dams and dunes
- Reinforcing 18 hydraulic structures

Room for the River

2005 2010 2015 2020

Budget

2.4 Billion

39 Projects

completed (including 5 cancelled)

Objectives
- Flood risk management: by river enlargement, reducing design water levels
- Improving spatial quality

Zand- en Grensmaas

2005 2010 2015 2020

Budget

558 Million

55 Projects

Objectives
- Flood risk management for the river Meuse
- Improving spatial quality
- Financially self-sufficient project by means of mineral extraction

LRT (2011/2013)

Flood Protection Programme 2014-30

2005 2010 2015 2020

Budget

4.9 Billion

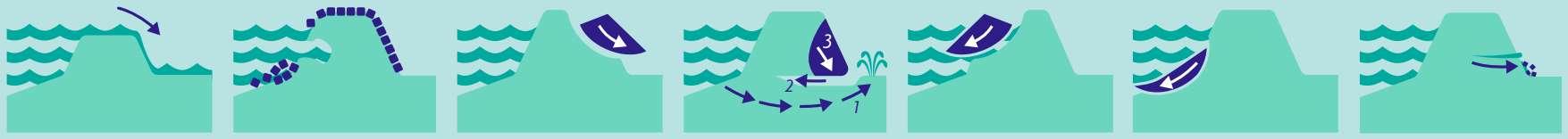
50/50
Government / Water board

943 km dykes

468 hydraulic structures

Objective
- Improving primary flood defences

Failure mechanisms that prevent flood defences from meeting the standard

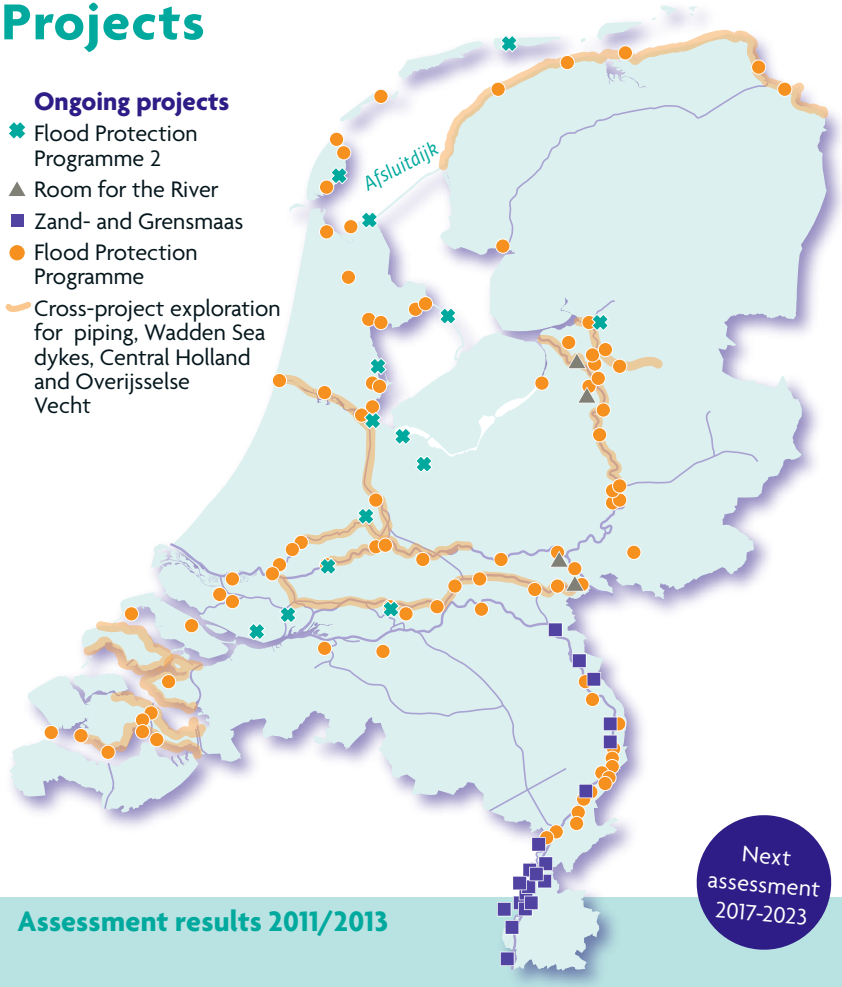


all amounts are expressed in euros

Projects

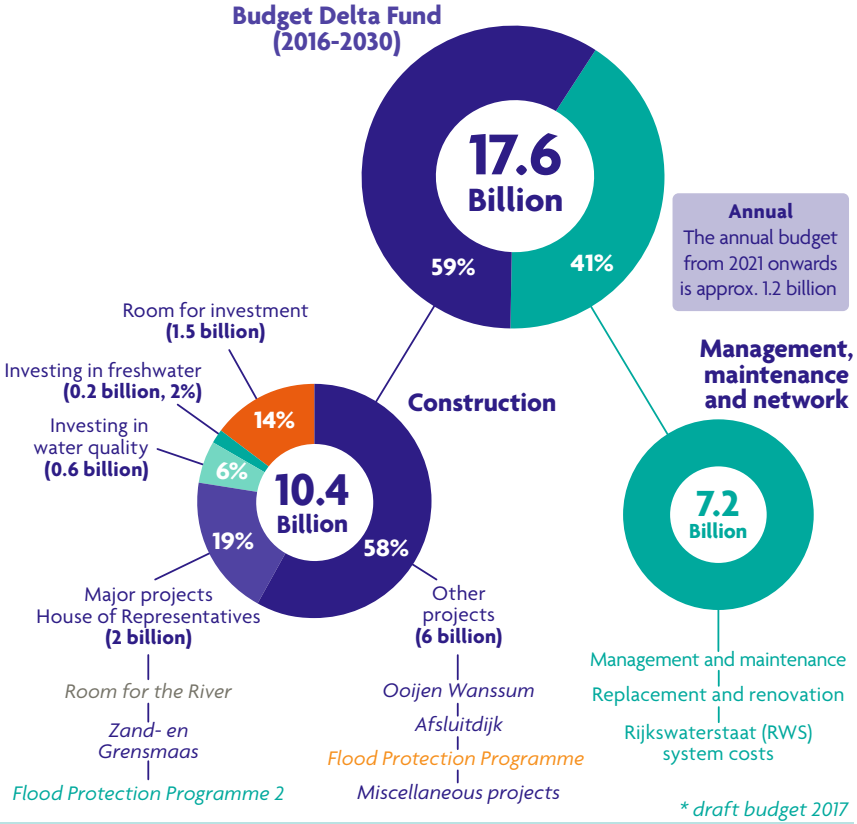
Ongoing projects

- Flood Protection Programme 2
- Room for the River
- Zand- and Grensmaas
- Flood Protection Programme
- Cross-project exploration for piping, Wadden Sea dykes, Central Holland and Overijsselse Vecht



Assessment results 2011/2013

Finances*



Financiën in 2017

Budget: 1.1 billion

- Construction: 0.6 billion
  - Major projects : 370 million
  - Other projects : 160 million
  - Water quality : 26 million
  - Freshwater: 39 million
- Management, maintenance and network: 0.5 billion

Flood risk management policy

Tolerable individual risk

The probability of an individual dying as result of flooding from a sea or river may not be higher than 1 in 100,000 a year.

Additional protection

If a flood results in major social disruption, such as a large number of victims or major economic damage, the area receives additional protection.

Examples

- A large number of victims: Alblasserwaard
- Major economic damage: Wageningen (Grebbedijk)
- Natural gas installation in Groningen
- Nuclear power plant in Borssele

Risk calculation

This takes into account both the probability of floods and the consequences of a flood. The consequences of a flood determine the flood risk that is deemed acceptable.

Flood defence systems

There are some **3,400 km** of dykes, dams and dunes in the Netherlands that provide protection against the sea, major rivers and lakes. These are the primary flood defences. They are largely managed by the regional water boards. The Central Government (RWS) manages approx. **250 km** of these.
The approx. **14,000 km** of regional flood defences, such as storage basin dykes and dykes along regional rivers, are also managed by the water boards. A little under **500 km** is managed by RWS. Along the major rivers, RWS manages approx. **3,800** hectares of flood plains, some 10% of the total surface area.

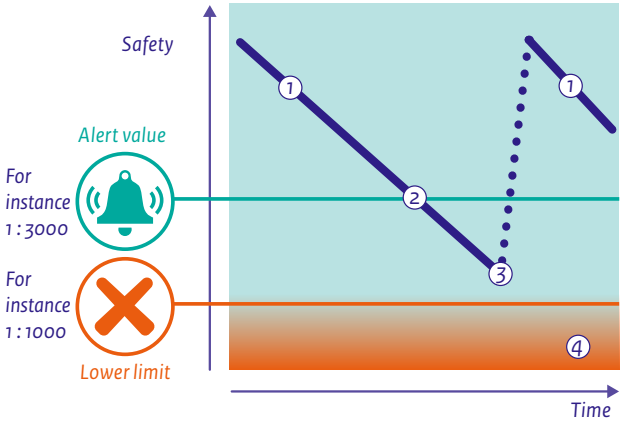
Safety and lifespan of dykes

Safety assessment

There is still ample time to reinforce the dyke to continue to meet the agreed protection level.

The periodical assessment by the national government will issue an alert if the government needs to take action.

Safety development during a dyke's lifespan



1. *Safety decreases due to increasing water levels (due to climate change) and decreasing dyke strength (due to aging).*
2. *Preparations can start as soon as the alert value has been reached.*
3. *Before the lower limit is reached, reinforcement of the dyke starts.*
4. *Below the lower limit, the agreed standards are no longer met.*

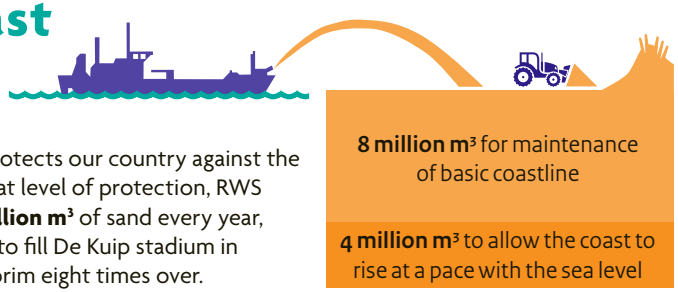
Afsluitdijk (IJsselmeer Closure Dam)

The dyke embankment of the IJsselmeer Closure Dam (1932) is 30 km long and some 90 metres wide. The dyke no longer meets the standard and will therefore be reinforced in the period from **2017 until 2022**. It will be rendered resistant to wave overtopping along its entire length. Pumps in the discharge complex at Den Oever serve to increase the discharge capacity of the IJsselmeer Closure Dam. The budget for these measures is **EUR 869 million**.
At Kornwerderzand, a fish migration channel is being dug for migratory fish such as eel, smelt, whitefish and salmon. Construction will cost **EUR 55 million**.

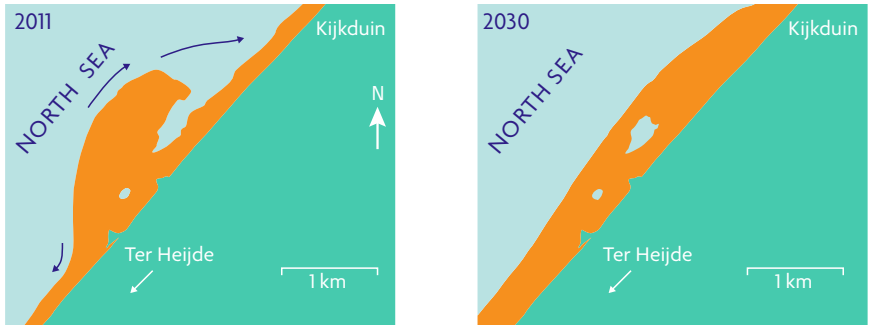
The coast

Coastal replenishments

The Dutch coast protects our country against the sea. To maintain that level of protection, RWS applies some **12 million m³** of sand every year, a quantity enough to fill De Kuip stadium in Rotterdam to the brim eight times over.



Sand Engine



The Sand Engine is an innovative way of protecting the coast using nature itself. It was constructed in **2011** between Ter Heijde and Kijkduin as a **128-hectare** peninsula (256 football pitches). Wind, waves and current will spread the sand along the coast over the next twenty years. For its construction, **21.5 million m³** of North Sea sand was used. Since its construction, **3.5 million m³** of sand has moved, more than half of which to the north. Construction cost **EUR 70 million**.

Facts about the coast

The coast is **523 km** long, of which 353 km is North Sea coast (incl. 254 km with dunes), the rest is located along the Wadden Sea and the Westerschelde.

In recent years, the coast has been reinforced where this proved necessary. Where possible, this reinforcement was combined with other functions, such as a car park in a dyke at the foot of the dunes in Katwijk. To reinforce the Hondsbossche en Pettemer Zeewering, a 5-km long dune comprising approx. **30 million m³** of sand has been deposited.

Improvement options

Incorporation - e.g. dyke reinforcement, taking into consideration existing use

River widening - instead of dyke reinforcement

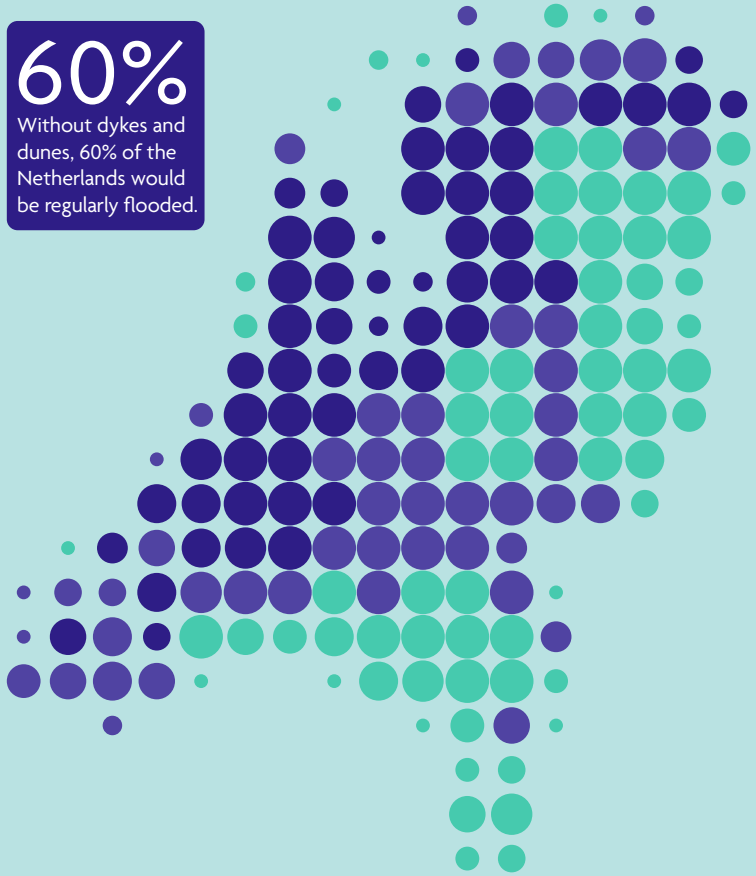
Linkage - with limited extension of designated uses

Integrated area development - with large-scale extension of designated uses

Other combinations - measures in spatial development and/or emergency response can also ensure protection (against flooding)

Flood risk management

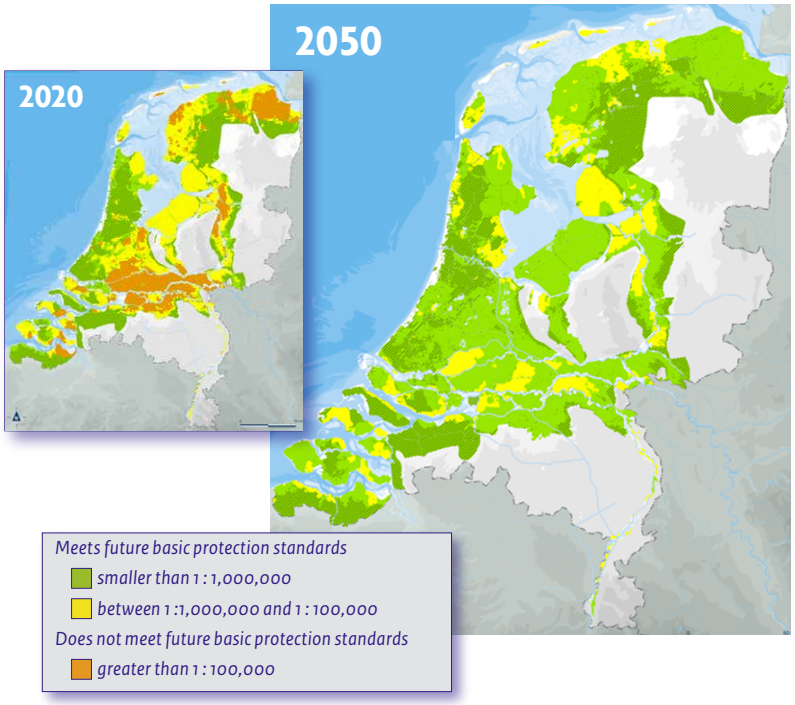
60%
Without dykes and dunes, 60% of the Netherlands would be regularly flooded.



facts about our water

Protection in 2050

Probability of dying as result of flood



Ministry of Infrastructure and the Environment
Directorate-General for Spatial Development and Water Affairs
Water Policy and Safety department

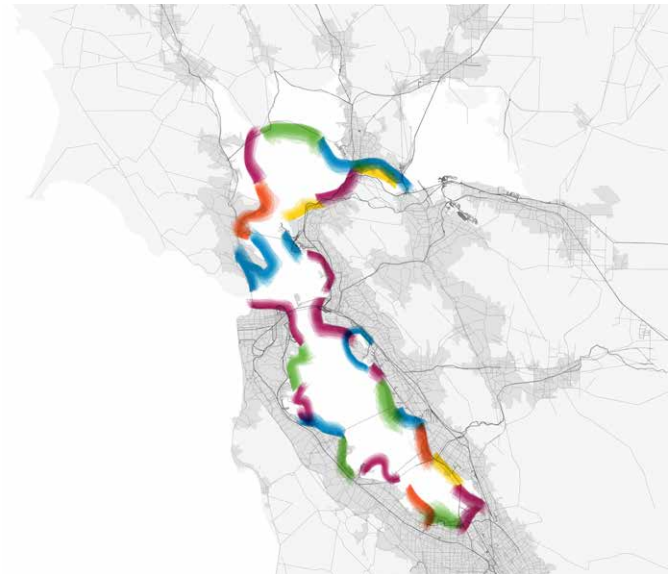
For more information, go to
www.government.nl/topics/water-management
www.destaatvanonswater.nl

Design: Rikkers Infographics
June 2017

facts about our water

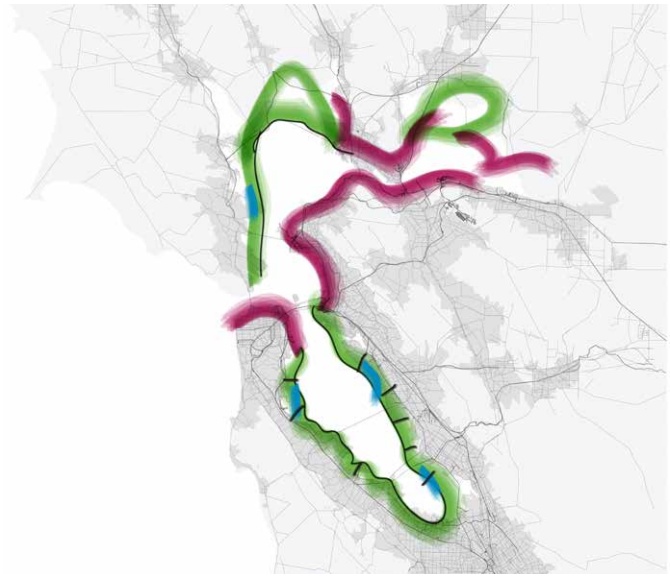
Flood risk management:

Impact on the Bay Area



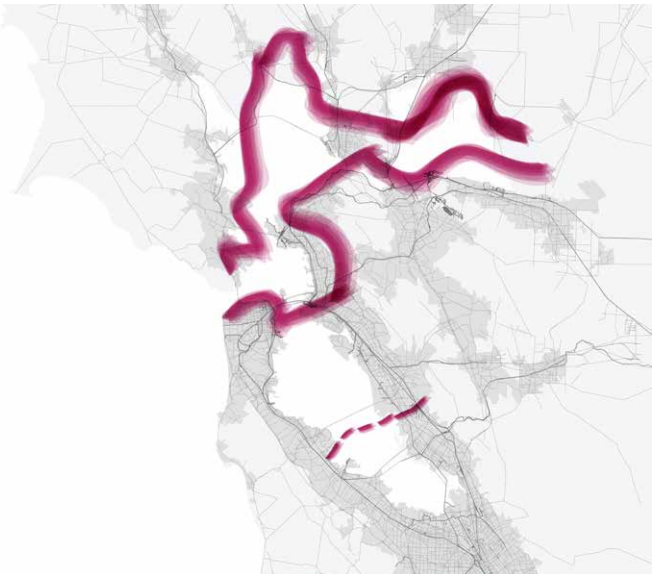
Individual (business as usual) adaption

In this scenario all measures are mainly reactions on local flooding problems and initiated by local authorities or land owners(hotels). Drought, subsidence and water quality have less priority.
To adapt Bay storm levels and SLR Bay levees are reinforced and raised based on local plans. High peak discharges from local streams will be solved by creating more local storage



Collective(nature based, second berm approach)

This scenario could be developed by and for nearly the whole Bay area. The idea is to design a SLR-proof (green) levee in front of the existing embankment where possible. The area in between can be split in compartments serving for: downhill stream water storage (shoreline collectors) to reduce stream flooding in the downstream area, recreation, fresh water reservoirs, wetlands/marshes.
There will be still areas where 'hard' measures are needed.
In a collective approach also additional water issues can be tackled together. For example solving water scarcity, salt water intrusion and Bay water pollution by a collective approach to improve waste water treatment and re-use this water for irrigation, making groundwater pumping unnecessary.



Collective (Zuiderzee approach)

This scenario is inspired by the Dutch Zuiderzee and Delta plans: shorten the coastal defense line. In The Netherlands this was/is also combined with additional functions like: improving transport routes, creating extra land for urbanization and agriculture. This scenario becomes more prominent when sea level rises more than forecasted at this moment. Only the South Bay can be considered for this solution. The North and East Bay need hard and/or second berm solutions, or retreat scenarios. In the South Bay the construction of a tidal/storm gate will be most efficient near San Francisco (A), but also other location could be interesting. The gate need to be constructed in a way that it can function as a storm gate in the beginning, later as a storm-tidal gate, followed by (leaking) closed gate. Improvements of the shoreline in South Bay will not be necessary and also risks of stream flooding will be reduced. Learned from Dutch experiences the South Bay should be kept brackish-salt. The gate must also leaking salt water in future.

Sustainable mobility tools

Sustainable mobility tools make it possible to understand the interrelationship between the different modes of transport, and to link transportation planning better to spatial planning. With these tools, it becomes possible to demonstrate the impact of more sustainable modes of transport (walking, biking, light electric vehicles, transit) over cars, and stimulate investments in them (especially since 50% of all car trips in the Bay are less than 5 miles). A host of complementary tools, from integrated fare, management and information systems to the construction of attractive interchange points, both big and small, where people can switch modes, make a modal shift easier and more sustained. This shift will be more comprehensive by concentrating the majority of the land-use development within cycling and walking distance of high quality transit stops. This will increase transport options for people who do not (want to) own a car and make it easier to address the first and last mile problem for longer trips. For the Bay Area such tools could help to improve health and safety, increase resiliency of the network, make the transport system more sustainable and communities more attractive.

Tools for sustainable mobility:

Cycling policy and designing active streets

The Dutch have the highest cycling share in the world. Of course a flat country and a moderate climate helps, but the high share of cycling we have today is mostly due to deliberate policies that originated in the seventies. Right before this time, the number of cyclists was dropping dramatically as a result of rapid motorization and a disregard for cyclist's safety. Since then, the picture has shifted considerably due to a combination of policies aimed at improving cycling infrastructure, designing safe roads, educating young people, implementing traffic calming measures and providing better protection of cyclists by law.

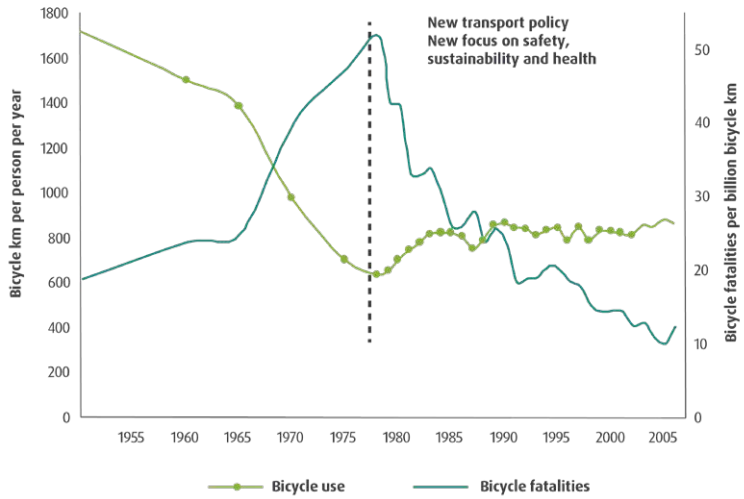


Figure: History of bicycle safety in The Netherlands

The best bike plan is a car network and management plan

An environment that is dominated by fast moving cars is not enjoyable for cyclists. To create an environment in which cycling can grow we first have to focus on the car network. By concentrating through traffic on a limited number of main arteries we can create safer environments on other streets where traffic speeds are slowed down. Cycling facilities can then be improved and parking policies can be tightened. Within the city, we can discourage small trips by car by cutting off streets for through traffic (only allow right turns for cars). Finally, we can use traffic management to prioritize cyclists at traffic lights and buffer car traffic in places where pedestrians and cyclists are not directly protected.

Separation, cycle highways and shared space

The history of Dutch cycling infrastructure has gone trough several phases. The first phase focused on building separate bike path/lanes along existing car infrastructure to improve safety. The second phase focused designs on stand alone "cycle highways" that offer both faster and more attractive routes (not next to cars moving). These cycle highways made it possible to use both the bike and the e-bikes for commuting distances up to 10 miles which has greatly relieved congestion on the highway network.

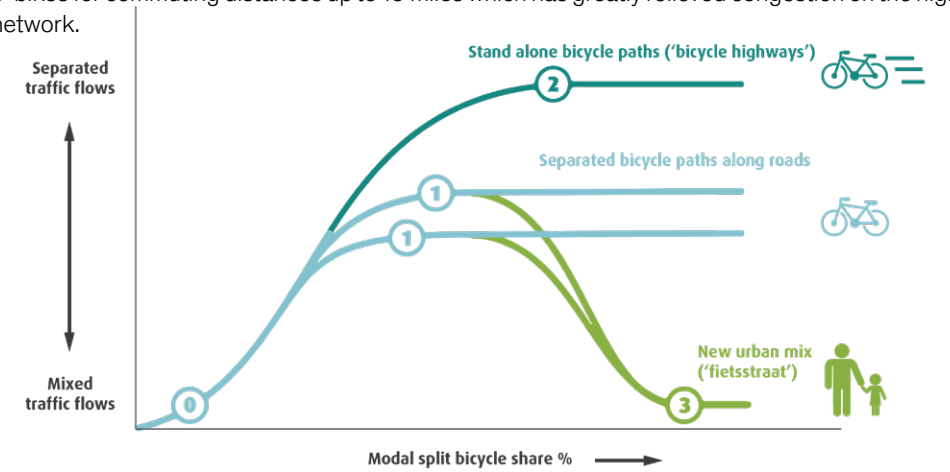


Figure: the three phases of cycling infrastructure in The Netherlands

On streets with high shares of cycling, the approach of separated infrastructure for cars and bikes does not always work. The bicycle lanes become over-crowded and the street feels completely dedicated to traffic rather than people. Due to this, certain streets are designated as shared spaces and designed more in the style of a public space (see example). After the redesign, the number of cyclists increased by 50% and number of cars decreased by 30%

before: separated bicycle paths along roads (1)

after: new urban mix (3)

Cycling policy and designing active streets:
Impact on the Bay Area

Opportunity | Active corridors: combine water management + green + walking and cycling

Building on the work of the Bay Trail, a network of active corridors could be developed that combine water storage (bioswhales), large and small green spaces and well-designed infrastructure to bike and walk. This network should not only be for recreational use, but should also link to transit hubs, employment centers, shopping malls and communities of concern to create a cycle network that people can use for both necessary travel as well as leisure.

Rethinking the grid

The dominant grid network for cars has delivered an excess of road capacity and asphalt that not only deters people from cycling but also adds to flood risks and heat. This excess of road space should instead be transformed for other uses (i.e. bike lanes, trees, and water storage).
The grid network, if planned with the bicycle in mind, can also achieve short cycle distances and low numbers of vehicles on residential streets. The Bay Area could take inspiration from Barcelona where they are creating 'super blocks' within the grid that do not allow through traffic by car to make more room for walking and cycling and public use. It might be hard to convince communities to implement such a strategy, but once the first example is there and people like it others will follow.

Impact: cycling is key to improving health and decreasing emissions

Over 50% of all car trips in the Bay Area are under 5 miles, a distance that could easily be cycled. The steep hills in downtown San Francisco might be a deterrent to bike, but ultimately large parts of the Bay Area are flat and easily accessible by bike. We are also seeing a rise of electric bikes or other small electric vehicles that will be able to assist riders up steeper grades. If short car trips would shift to the bicycle this would help decrease CO2 emissions, improve health, increase transport options for low income communities and help to battle congestion. Our visual highlights the impact that a 10-20% reduction of short car trips could have on CO2 emissions and air quality.

Impact of regional applicability

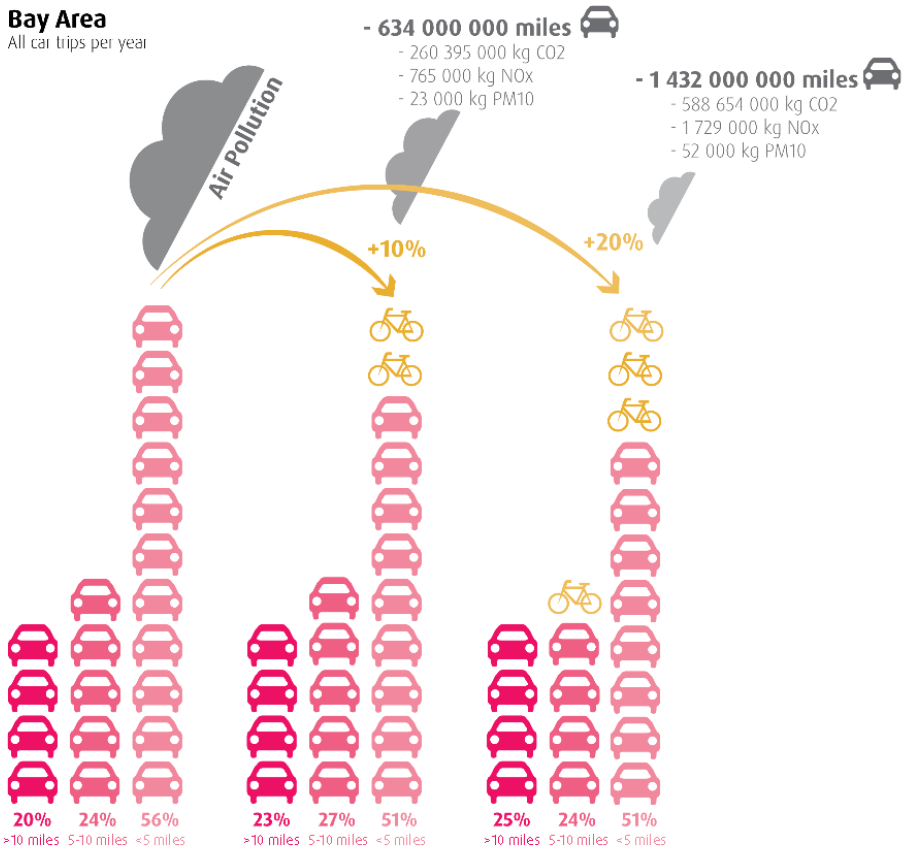


Figure: Possible shift of car trips and emmission reduction in the Bay Area

Tools for sustainable mobility:

Planning for integrated transit systems

The Netherlands has one of the best and most cost-efficient transit systems in the world. The way different transit systems (train, metro and bus) and other modes (bike, car) are integrated is an important part of this success. In addition to the integration between modes of transit, land-use policy and development plays a crucial role in the success of our transportation system. Cities cannot grow without efficient transit systems. Most big cities in the world have a combined market share for walking and cycling of about 70%.

Collectively plan ahead

Currently the national government, transport authorities, cities and transit providers are working on a new future vision for the Dutch transit system. This vison needs to lay out how the transit system can keep up with growing population in cites and more travel between cities in the region. This collective vision is an important factor in the success of Dutch transit systems. It helps to determine which investments are crucial to the whole system and how different transit providers can contribute to the same vision.

Which places need to be connected?

This visioning starts with defining the different urban concentration that need to be connected to transit, based on their density of jobs, residents and visitors and type of activities (hospitals, shopping centers, headquarters, airports etc..). For each of these urban magnets an ideal transit connectivity and modal share is proposed and compared to the current mode share and connectivity to see to which magnets connectivity needs to be improved.

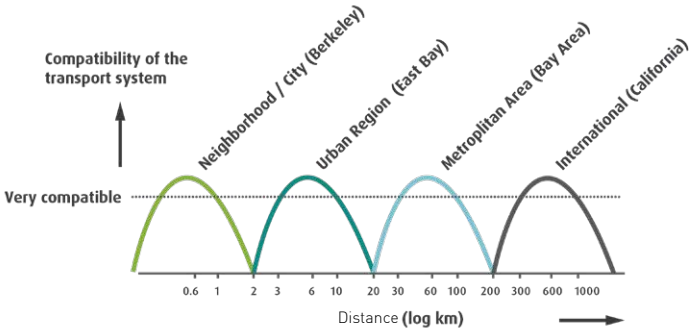


Figure: Compatibility of transport systems linked to the distance

Hierarchy is crucial

Successful transit systems also need hierarchy to serve different types of trips. A fast intercity connection with few stops should service the most important urban centers. Frequent and rapid regional trains and busses should serve daily commuting patterns on the busiest corridors and on a local level, busses, transit on demand and shared bikes should be used a first and last mile solution. In the Bay Area, this hierarchy is missing on a regional level and is lacking at a local level resulting in an inefficient transit system.

Combine train and bike

An important factor of a competitive transit system is the combination of bike and train. The bike, which offers the flexibility of door-to-door travel, combined with the speed of the train for longer distances, can potentially offer the same accessibility in urban areas as the car. The Netherlands has continuously invested in high quality bike parking at stations and improving access to the station by bike. A recent success story has been the bike-sharing program, OV-fiets. OV-fiets, which can accessed through your transit card, offers people the opportunity to use the bike for both the first and last mile. Number of trips has grown exponentially since its introduction 15 year ago to 3 million trips each year.

Integrated fares, information and coherent design

The Netherlands is the only country in the world with a transit card that can used throughout the country for all different modes of transit. There are also cards that you can use to rent a bike, get a taxi, pay for park and ride or get a rental car. The information on stations has been standardized and the design is of high quality and coherent, so people understand how to navigate stations no matter where they are. Lately a lot of attention is paid not only to speed and costs, but also to the use experience of transit travel.

Planning for integrated transit systems:
Impact on the Bay Area

Opportunity | Introducing intercity's and bus rapid transit

Introducing fast trains, between major centers in the bay area will not happen overnight, but the electrification of the CalTrain corridor offers the opportunity to introduce more hierarchy in the transit system. Fast connections between Silicon Valley and downtown San Francisco are of great economic importance (probably more than high speed trains to Los Angeles). Furthermore, the region should work together on a Bus-Rapid-Transit system that serves important commuting patterns not served by rail. Extending and improving the BART system should not only be about adding capacity, but should include fast tracks to bypass stations and introduce more hierarchy in the system

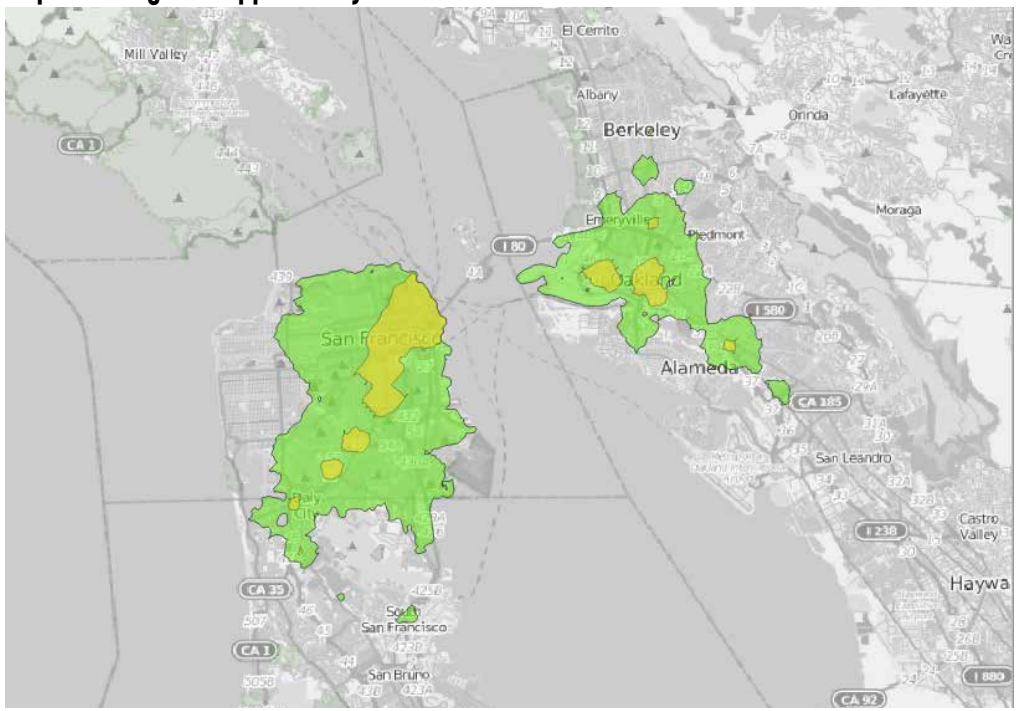
Develop bike share and transit together

Shared mobility options are popping up everywhere around the Bay. A step could be made to better integrate these initiatives with transit systems. For example, focusing more on car sharing and e-bikes in less densely populated areas with longer first and last mile trips and bike sharing in urban centers. Also integrating the bike sharing programs with the clipper card (like Ford Go bike) is a step in the right direction.

Impact: 20% mode share from driving to transit possible

The combination of bike and transit can drastically increase the catchment area of the transit systems as the example shown below clarifies for access to jobs from downtown San Francisco. The combination of bike-transit-bike (green area compared to yellow area) results in a 71% increase of the access to jobs accessible within 30 minutes. Of course this would require improved cycling infrastructure to station, quality bike parking and shared bikes for last mile connections but is shows the enormous potential of the combination of train and bike.

Impact of regional applicability



Catchment area train compared with catchmentarea train with bike leads to a 71% increase in access to jobs > 400.000 jobs

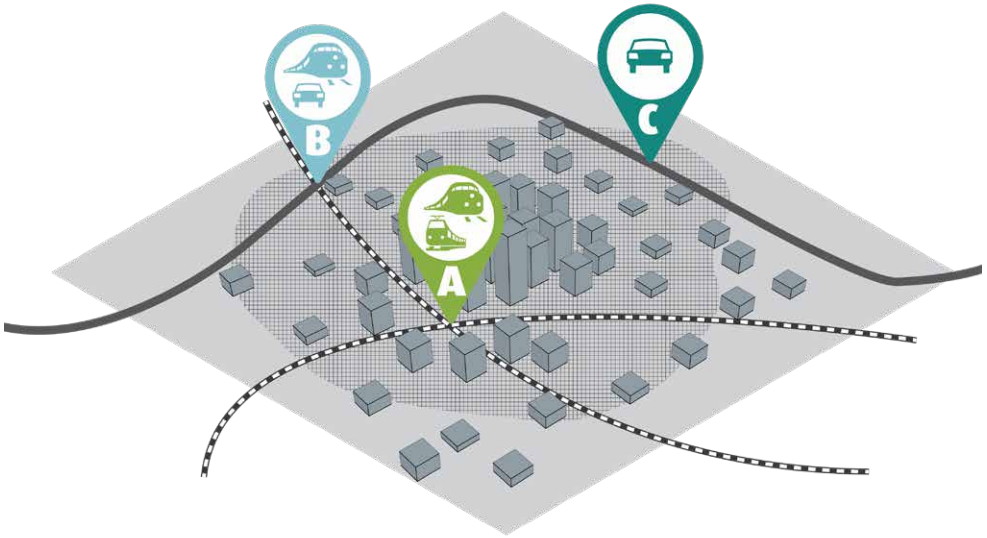
Tools for sustainable mobility:

Transit oriented development and parking

The Netherlands has a long tradition of integrating transport and land-use planning. This started with the development of new towns along corridors of the national railway system in the 70's. Houten is a famous example of a new town that is designed around the train stations, where the bike is also the fastest mode for all short trips.

ABC: location policy

In the early 90's the ABC location policy was developed to find the right accessibility for every facility. Facilities with high numbers of workers and visitors (such as universities, hospitals, civic centers) should be placed near hubs in the transit network (A-location), facilities with high number of workers and lots of business trips should be placed at locations with good access by car and public transport (B-location) and facilities with low number of workers and higher number of freight traffic (C-location) should be placed near highways. This was also combined with a parking strategy with only 1 parking spot for every ten workers in an A-location and 1 for every 5 workers in a B-location.



Parking Balance

Although the ABC location parking policy was effective from a mobility point of view, some viewed it as too rigid. One way we solved this was to work with a total amount of parking in a new development based on the 1:10 ratio and promote shared use of facilities. This let future users negotiate about the amount of parking each and everyone gets where companies with less parking benefit financially and companies that need more parking must pay more.

Attractive design of major interchanges and mixed-use

With the addition of the new high-speed rail lines to France and Germany and rapid connections to Schiphol airport, the central stations in our network (i.e. Amsterdam and Rotterdam Centraal) have become very attractive for economic development. To make sure these locations also become new focal points in the city (and not only monofunctional business districts) extra attention was paid both to the design of the stations and surrounding public spaces as well as promoting mixed-use around the stations. This also meant making the direct environment around the transit hubs free of cars (through tunnels or traffic calming measures) so people can walk straight into the city.

Transit oriented development and parking:
Impact on the Bay Area

Opportunity | Upgrade of the Caltrain corridor and high-speed train

The upgrade of the Caltrain corridor with to the extension to the Salesforce Transit Center and the future high-speed train connection to the Central Valley and Los Angeles offers tremendous opportunity for an integrated approach to Transit Oriented Development. The increase of accessibility will attract land-use development. To use this energy in an effective way, cities along the corridor should work together to capture value and stimulate mixed-use higher density development and affordable housing and make sure these new transport hubs are not left in splendid isolation, but well connected to the neighborhoods surrounding the stations so much more people will have increased transport options. Implementing a parking strategy together that every city can implement is much easier than if you have to do it on your own. The Amtrak corridor in the East Bay could maybe be redeveloped in the same way in the long run in combination with taking measures against sea level rise.

Impact: TOD produces 6 times less VMT than sprawl

In the Netherlands transit share between main hubs reaches levels of up to 50%. A quick comparison was made, between locating 10.000 residents close to transit in Berkeley combined with a parking strategy and locating 10.000 resident is Vallejo not close to high quality regional transit. The residents in Vallejo will drive alone 75% of the time, while Berkeley residents close to transit will only use the car half as much. In terms of vehicle miles traveled the difference is more profound with the residents in Vallejo driving 6 times more miles than Berkeley residents since they also have to travel further to reach jobs. Land-use development in Vallejo will also increase traffic congestion on the network and negatively impact access to jobs for a much bigger part of the population in the North Bay. Adding 10.000 residents close to transit in Berkeley hardly impacts congestion on the road network.

Tools for sustainable mobility:

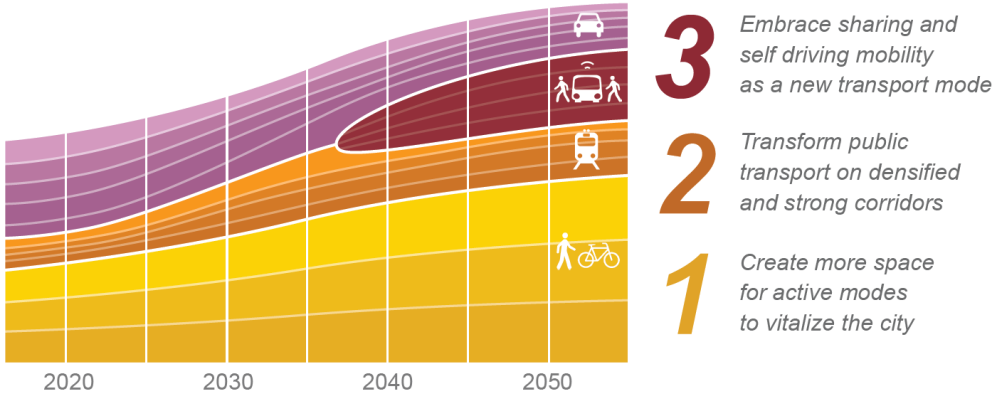
Mobility Hubs

As cities grow transport needs to be more efficient

In the Netherlands more and more people are moving to cities. An increase in the number of residents, jobs, and visitors of cities will lead to more traffic. In the case of inner-urban densification in an existing city, it is therefore desirable that the growth in mobility is absorbed without being at the expense of the physical space within the city. Often there is space to expand transport networks within an existing urban area.

Infill development that does not lead to cramped roads requires a shift from car use to walking, cycling, public transport, and shared mobility which goes beyond current transport policy goals. The total use of space for mobility results from the combination of the number of people in the city, their distribution across the various modes of transport, and the use of space per person for each mode.

Therefore, in order to keep the total use of space for mobility at the same level, despite the increasing population, it is necessary for people to opt for more space-efficient forms of mobility (walking, cycling, public transport and shared mobility). An innovative mobility concept is needed to guarantee future inhabitants a high-quality mobility-system and an attractive neighborhood.



3 *Embrace sharing and self driving mobility as a new transport mode*

2 *Transform public transport on densified and strong corridors*

1 *Create more space for active modes to vitalize the city*

Mobility hubs: more transport options with less use of space

The concept of multimodal mobility hubs was worked out as the innovative solution for innercity development in Utrecht. This multimodal mobility hub ensures future inhabitants of the neighborhood a good mobility product. The mobility hub consists of a physical mobility shop, mobility services and a digital platform (as an app). Among other things, these hubs focus on:

- car sharing (with cars available in the area's underground carparks);
- a high-quality Public Transport (HQPT) connection (Merwede will have an HQPT connection with various stops, initially in the form of a high-quality bus service);
- on-call taxis (and in the longer term even self-driving vehicles on call);
- self-service pick-up kiosks for parcels (a self-service pick-up kiosk will be installed in each carpark);
- bicycle sharing (residents will be able to access a standard shared bike every few hundred metres); and
- availability of everyday facilities such as a dry-cleaners or a coffee bar around the hub.

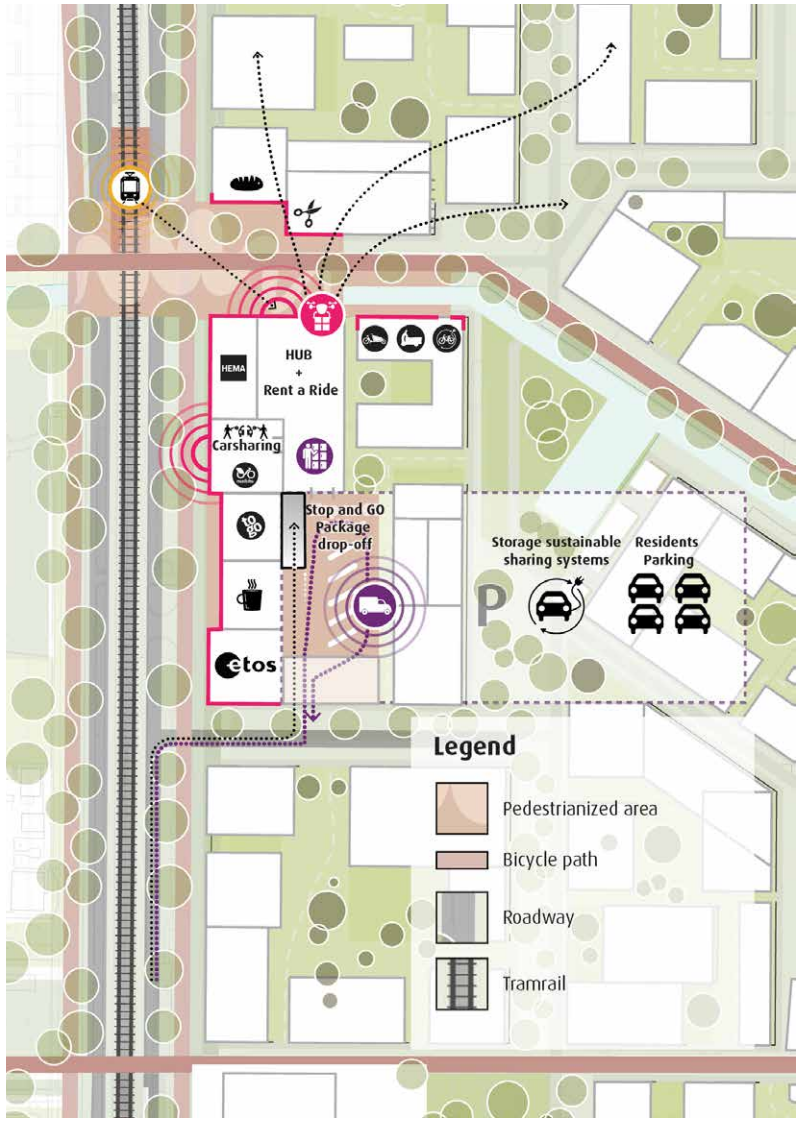
The mobility hub has to be well designed and will have a central place within the neighborhood in close walking distance of where people live and work and next to high quality public transport.

Reorganize life around mobility: sharing versus owning

Part of today's society is already prepared to reorganize their life around mobility, such as by using Mobility as a Service rather than owning a car. Even real estate developers themselves indicate that parking facilities are partly empty among their new developments in cities. In other words, people living in cities nowadays organize their mobility in different ways, making it so they no longer need a private parking spot. As a result, current parking norms are often too high.

Parking conditions for a mobility hub

The mobility concept for the new neighborhood results in the realization of a low amount of parking spots, which saves developers a significant amount of money. It is crucial for municipalities to make developers a copartner of the investment in this new, innovative mobility concept. Since they save money on lower parking requirements, they have the financial resources to contribute to different kind of mobility services and products. Real estate developers can and are willing to contribute substantially to make this new innovative mobility concept a reality. An important tool to decrease traffic in high density areas is the parking ratio. Utrecht uses low parking ratios to stimulate a) walking, b) cycling and c) public transport. This shows that Utrecht has a high ambition level to achieve the goal of reducing the amount of cars in their city. It is important to also think about the parking strategy for adjacent neighborhoods to limit spill-over effects.




HUB
HUB

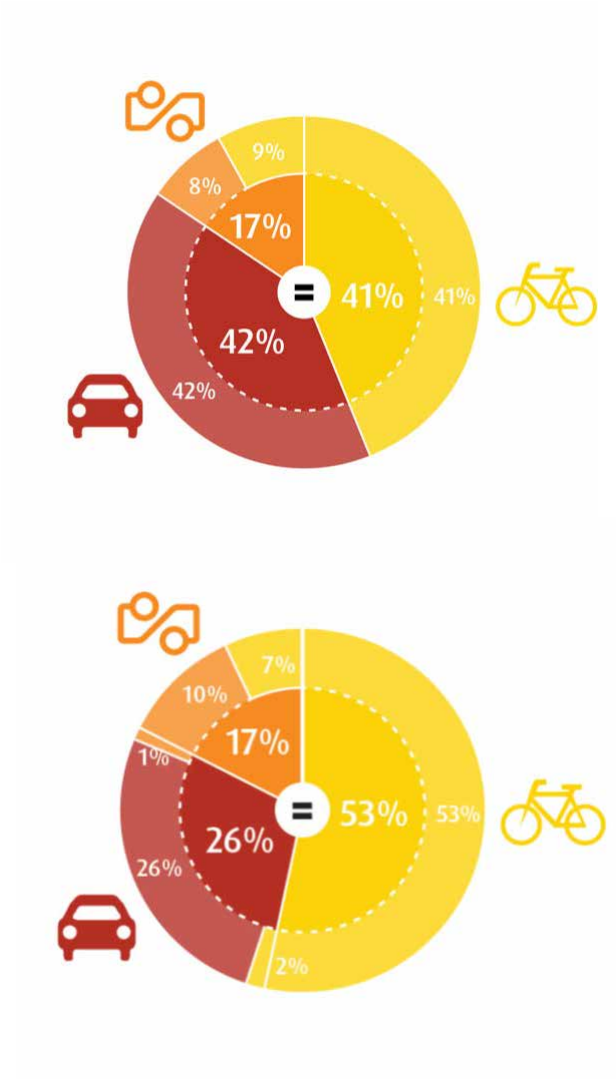
Mobility Hubs:
Impact on the Bay Area

Opportunity | Priority development zones should develop mobility hubs

With the land-use of today you are creating the mobility patterns of the future. It is important not to only concentrate new development in priority development zones close to transit, but also thinking about implementing a complementary mobility strategy that includes mobility hubs, a restrictive parking policy and promotes shared mobility. With the development pressure in the Bay Area, and many companies offering shared mobility solutions there is leverage to implement new forms of mobility. If cities coordinated the parking strategies for the development areas regionally this limits competition.

Impact: Mobility hubs can drastically decrease space taken up by the car

For Utrecht the difference between business as usual and the mobility hub strategy has been analyzed. The mobility hub leads to a decrease in the mode share by car of about 16% and increase in cycling trips. In the Bay Area the mode sharing off driving is higher, but similar shifts in mode share could be expected.



Area development tools

Area development tools bring stakeholders and owners together to create diverse urban environments with equitable access, integrated resource management and inviting public spaces. Added value, including economic value, can be best realized between voluntary actors if parties embrace a shared perspective and are prepared to combine their assets – temporarily – to realize that perspective. Climate risks and the related opportunities for a better region are such a compelling perspective. In order that parties understand and experience these benefits themselves, metrics, design and communication need to be developed together. In the Bay Area, intensifying land-use and integrating functions by better collaboration between governments, between governments and private actors, and between private actors, would release much of the land stress, create space for ecosystem services, and greatly reduce development costs.

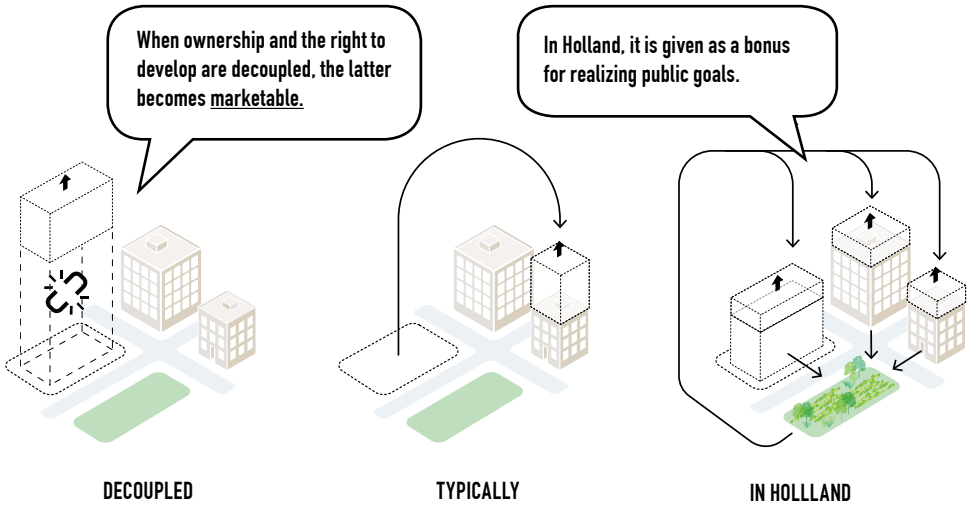
Tools for area development:

Transferable Development Rights

In the Netherlands, we have a long history with area development. Area development finds its origin in Dutch polder. Working together was necessary to keep dry feet and to keep both the sea and the rivers at bay. Area development is essentially about adding value from the realization that the whole is worth more than the sum of the parts. In essence, you can distinguish two axes in area development: the degree of integrality and the degree of cooperation (both public-private and private-private). As you want to realize more integrality and added value, more cooperation is needed. With this, the complexity also increases.

1. Transferable Development Rights

This method originates in the United States and has been adapted in the Netherlands. The essence is that the land ownership and the right to develop are decoupled. The right to develop becomes, as it were, marketable, so that an investor and / or a developing party can get started if it manages to acquire the development rights. In the original approach, the acquired development rights could also be deployed elsewhere, which was not developed within a joint perspective. In the Netherlands, however, this approach has been modified: there the transferable development rights have been applied according to the principle 'what belongs to whom. The right to develop is therefore placed in a future perspective, usually based on publicly defined goals. In exchange for the realization of public goals, development rights are issued. This approach is in line with the practice in the US, and stays away from the discussion about expropriation and focuses on realizing social goals with a bonus.



Examples in the Netherlands:

Gelderland and North Brabant
Tool applied in areas where the agricultural sector needed to be restructured. Entrepreneurs or developers can develop houses on condition that vacant buildings are demolished and tidied up. In Gelderland and North Brabant, experiments have been carried out based on this policy.

Province of Limburg
In exchange for clearing vacant buildings in area where more agricultural land is needed, development rights are issued. It is also referred to as the "red for green principle". In Limburg, this policy is anchored in the provincial regional plan, including a calculation model and a quality committee.

Possible locations in the Bay Area:

Oakland, Alameda
In Oakland in Alameda County, transferable development rights can be used as a bonus for the realization of public goals by industrial and commercial developers, such as water management, community amenities and better transit options.

Islais Creek, San Francisco
TDR can help industrial creek basins such as the Islais Creek Basin in San Francisco to densify vertically, freeing up space for water retention upland and retreat in the lowland areas. This allows both better water management and economic vitality.

Transferable Development Rights:

Impact on the Bay Area

Climate change adaptation benefits

Make space for water storage

Move program out of the floodplain

Retrofit urban fabric

Other resiliency benefits

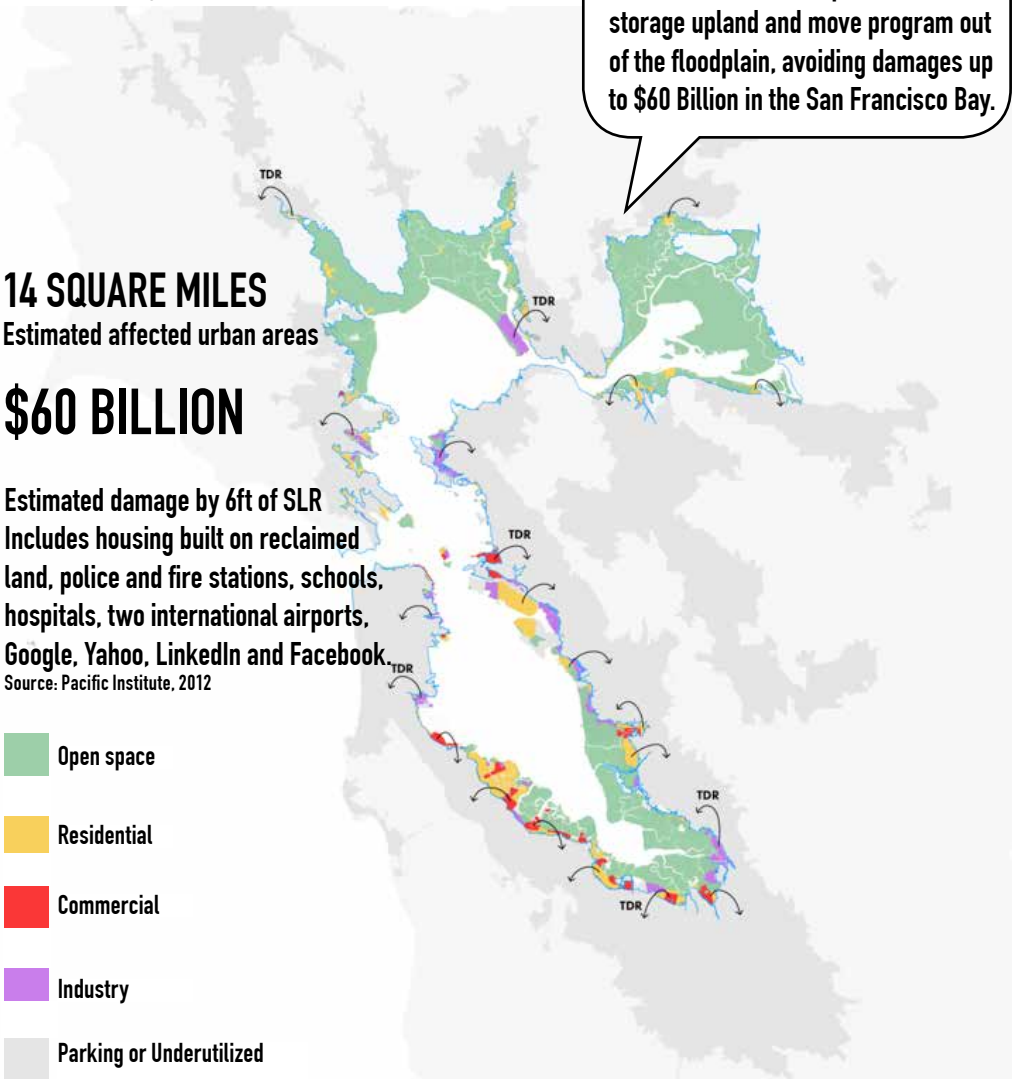
Create neighborhood amenities

Densify around public transport

Foster mixed use neighborhoods

Impact of regional applicability

TDR allows to create space for water storage upland and move program out of the floodplain, avoiding damages up to $60 Billion in the San Francisco Bay.



14 SQUARE MILES
Estimated affected urban areas

$60 BILLION

Estimated damage by 6ft of SLR
Includes housing built on reclaimed land, police and fire stations, schools, hospitals, two international airports, Google, Yahoo, LinkedIn and Facebook.
Source: Pacific Institute, 2012

- Open space
- Residential
- Commercial
- Industry
- Parking or Underutilized

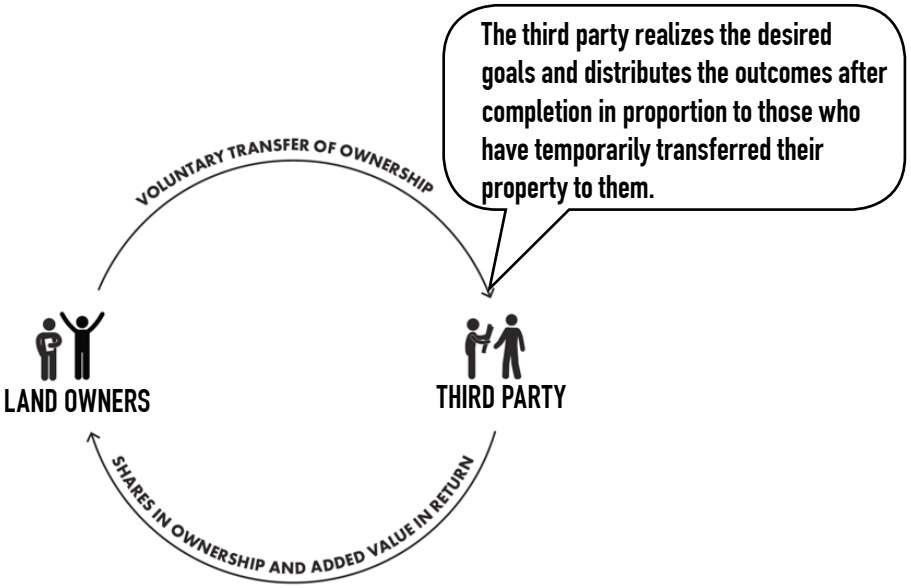
Tools for area development:

Urban Re-allotment

2. Urban Re-allotment

A variant of this is the urban re-allotment. In this case, the land ownership is transferred on a voluntary basis to a developing party. This party realizes the desired goals and added value and distributes the proceeds after completion in proportion to those who have temporarily transferred their property. You could say, as it were, that the landowners become shareholders in a development in order to realize a return and at a later moment redeem their share in the form of a proportional return and ownership.

Voluntary urban re-allotment has arisen as an idea in the years of crisis on the real estate market. Just then it became painfully clear that only by working together could the spiral be broken down. No solution has yet been found for dealing with so-called 'free riders'. Volunteering is leading.



Examples in the Netherlands:

Helmond, business park
After the foundation for the application of urban plot exchanges at the Induma West business park has been laid down in the 1st pilot phase, other sub-areas will now also be tackled. A cooperation of the owners remains focused on the restructuring of the site where the municipality also participates if necessary.

Winterswijk
In Winterswijk around 70 owners, investors, residents and other trendsetters participated in this urban re-allotment. The result: a series of deals in which superfluous square meters are withdrawn from the market and the demand is focused on the best spatial and economic best places.

Possible locations in the Bay Area:

San Jose, Santa Clara
Large areas with parking lots and underutilized spaces in San Jose can be rethought and densified using the Urban Re-Allotment Tool. Third party developers can help densify mixed neighborhoods, while at the same time owners can retain shares in ownership.

South San Francisco, San Mateo
The industrial areas on the waterfront in South San Francisco lack public amenities, transit options and diverse job opportunities. With Urban Re-allotment, local residents can achieve long-term environmental and economic goals on the neighborhood scale.

Urban Re-allotment:

Impact on the Bay Area

Climate change adaptation benefits

Protection offers increase in land value

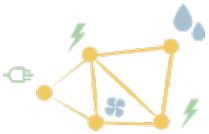
Collective flood protection

Retrofit urban fabric

Other resiliency benefits

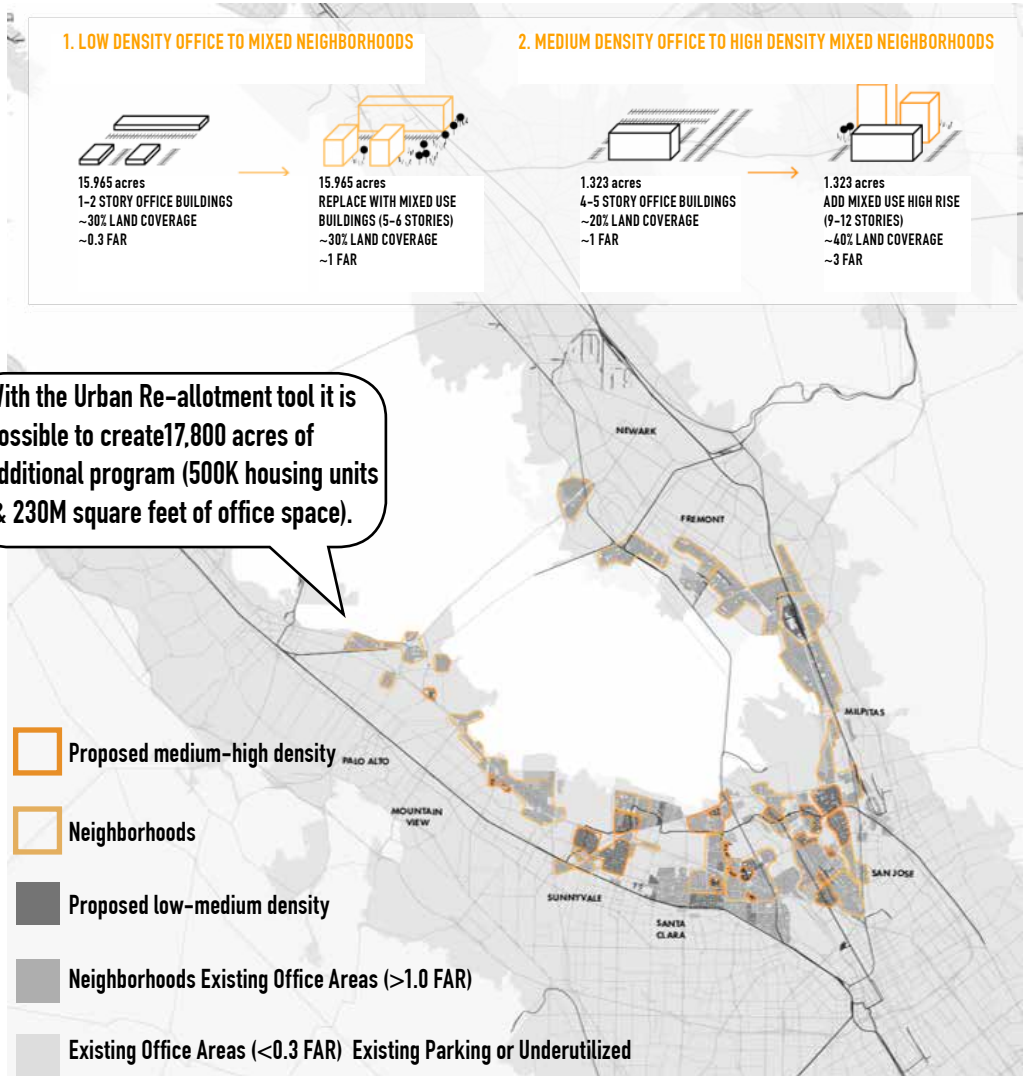
Enhance mixed neighbourhoods

Create space for infrastructure



Decentralize utility systems

Impact of regional applicability (South Bay)

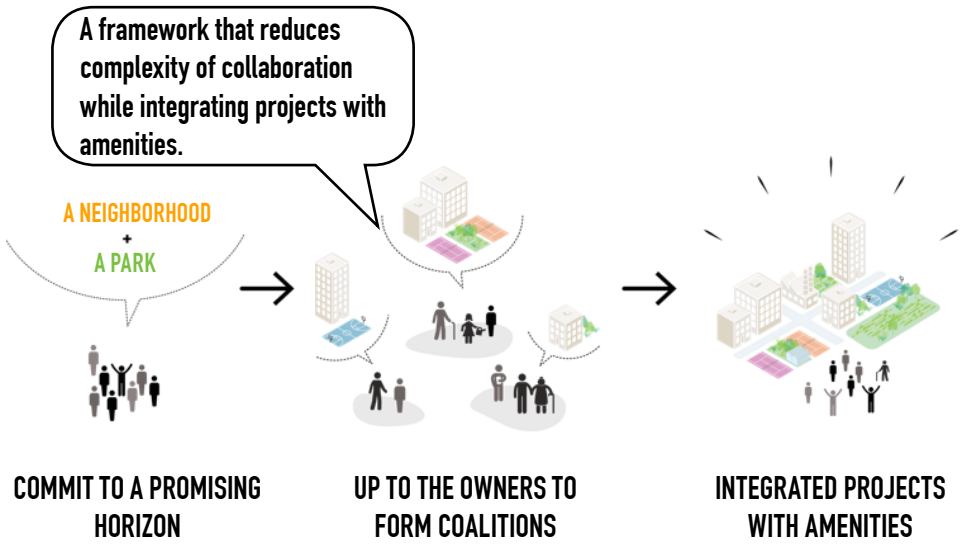


Tools for area development:

Developing Apart Together

3. Developing Apart together

A variation on the urban re-allotment is the so-called developing apart together. With this approach, the parties commit to a promising perspective in time and commit and within these frameworks it is up to the owners themselves to join together individually or in smaller coalitions. This reduces the complexity of the collaboration and assumes a kind of self-bonding or a public framework that is leading. The approach is still in its infancy. In the Netherlands (Amsterdam South-East) the first experiences are now being gained with this approach.



Local value creation:

Developing Apart Together can be linked to local value creation through a series of VALUE CAPTURE MECHANISMS that allow for organic development over time and foster lively and economically sustainable neighborhoods:

1. Co-Op models over individual ownership models
2. Community Land Trusts
3. Community Benefit Agreements with developers to contribute to Community Funds
4. Small Infill Projects over time
5. Aggregate small parcels for larger developments with community benefits
6. Mix low residential with local businesses

Examples in the Netherlands:

Buiksloterham, Amsterdam North
Buiksloterham is a unique neighborhood within Amsterdam that serves as a living lab for Circular, Smart, and Biobased development. Buiksloterham, on the northern bank of the IJ waterway, once the site of Amsterdam's most polluting industries, is being transformed into a sustainable area to live and work.

Possible locations in the Bay Area:

San Rafael, Marin County
In San Rafael in Marin County, the Developing Together Apart tool can help create necessary community spaces, evacuation areas and address aging infrastructure, in a simple and quick way (compared to normal planning processes).

Richmond, Contra Costa
The Developing Together Apart tool can be also applied in Richmond in the Contra Costa cunty to help address issues of environmental justice, open space and waterfront accessibility in a coordinate way as new development occurs.

Developing apart together:

Impact on the Bay Area

Climate change adaptation benefits

Quick method for CC adaptation

Use of collective methods

Simple organizational framework

Other resiliency benefits

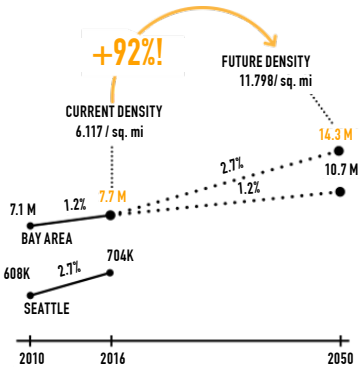
Integrated amenities

Mix and variability

Multiple scales

Impact of regional applicability

	2017	IN SLR FLOODPLAN	2050
Population	7.5 M	1.2 M	10.7 M
Density	6.117 / SQ. MI	5.200 / SQ. MI	7.673 / SQ. MI
Households	2.5 M	422 K	3.1 M
Urban area	1226 / SQ. MI	14 / SQ. MI	1212 / SQ. MI



Inclusive design tools

Inclusive design tools play an important role in developing highly efficient, yet qualitative urban environments in which people with various backgrounds are happy to interact, contribute and live together. They ensure we create places that not only serve technical, economic and environmental requirements, but also respect the individuality of people and their needs for privacy, personal spaces, social amenities and a lively community. Tools such as integral scenario thinking and -visualization, strategic visions and design guidelines also help us to manage serious dialogue between stakeholders, define collective, long-term goals and translate them into each smaller development. This enables systematic change through consistently taking little steps by various actors. Using inclusive design tools in the Bay Area can help to identify and agree on collective goals and join efforts in taking efficient steps towards a resilient Bay Area future. The tools can support the communication process with and between stakeholders and communities to foster awareness, understanding and collaboration for a resilient intensification of existing neighborhoods. Ultimately, this can relief pressure on vulnerable communities as well as on the health care-, mobility- and environmental systems.

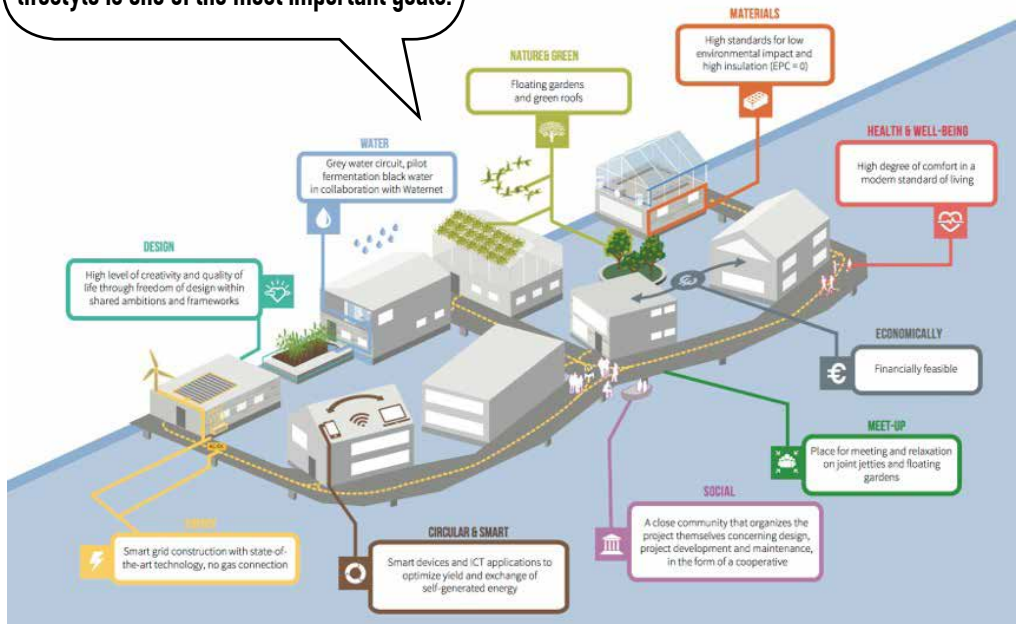
Tools for inclusive design:

Floating circular communities

4. Floating circular communities

Dutch designers, architects and developers are already thinking about floating neighborhoods in delta areas. Designers are proposing floating homes as a solution for a flood-prone new development area – the buoyant apartments will simply move up and down in sync with the water. In addition, the Circular City and Sustainability embrace themes like energy, intelligent use of materials, recycling, climate resilience, and sustainable mobility, as well as the shift from ownership to usership (sharing economy) and the development of new models for production, consumption, distribution and logistics.

Living together in circular economy terms means sharing resources – working together to search for a more sustainable lifestyle is one of the most important goals.



Schoonschip, Buiksloterham, Amsterdam North

Examples in the Netherlands:

Schoonschip, Amsterdam North
Johan van Hasseltkanaal, a canal from the IJ river (in the north of Amsterdam), will be the home of a floating neighborhood project called 'Schoonschip'. Literally, Schoonschip can be translated as clean ship. The neighborhood consists of homes for 46 households and a community center on 30 floating plots.

De Ceuvel , Amsterdam North
De Ceuvel is a planned workplace for creative/ social enterprises in Amsterdam North. The land was secured for a 10-year lease from the Municipality. Goal is to provide an example for closing nutrient cycles, clean the soil in a natural way, and experiment with new tech, while serving as a creative office terrain.

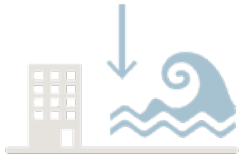
Possible locations in the Bay Area:

San Rafael, Marin County
Vulnerable communities near the canal area in San Rafael could mitigate flooding risks with this new type of floating neighborhoods that can adapt to sea level rise and because of their shared resources can alleviate low-income families from high utilities costs.

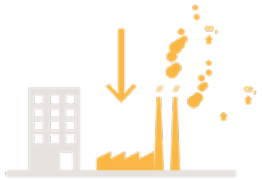
East Palo Alto, San Mateo
In the South Bay, salt ponds can be transformed into productive ponds, including floating neighborhoods that can foster mixed use environments and can help connect renewable resources with people's homes.

Floating circular communities:
Impact on the Bay Area

Climate change adaptation benefits



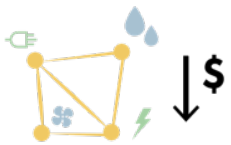
Reduced flood risk



Reduced emissions

Living with water

Other resiliency benefits

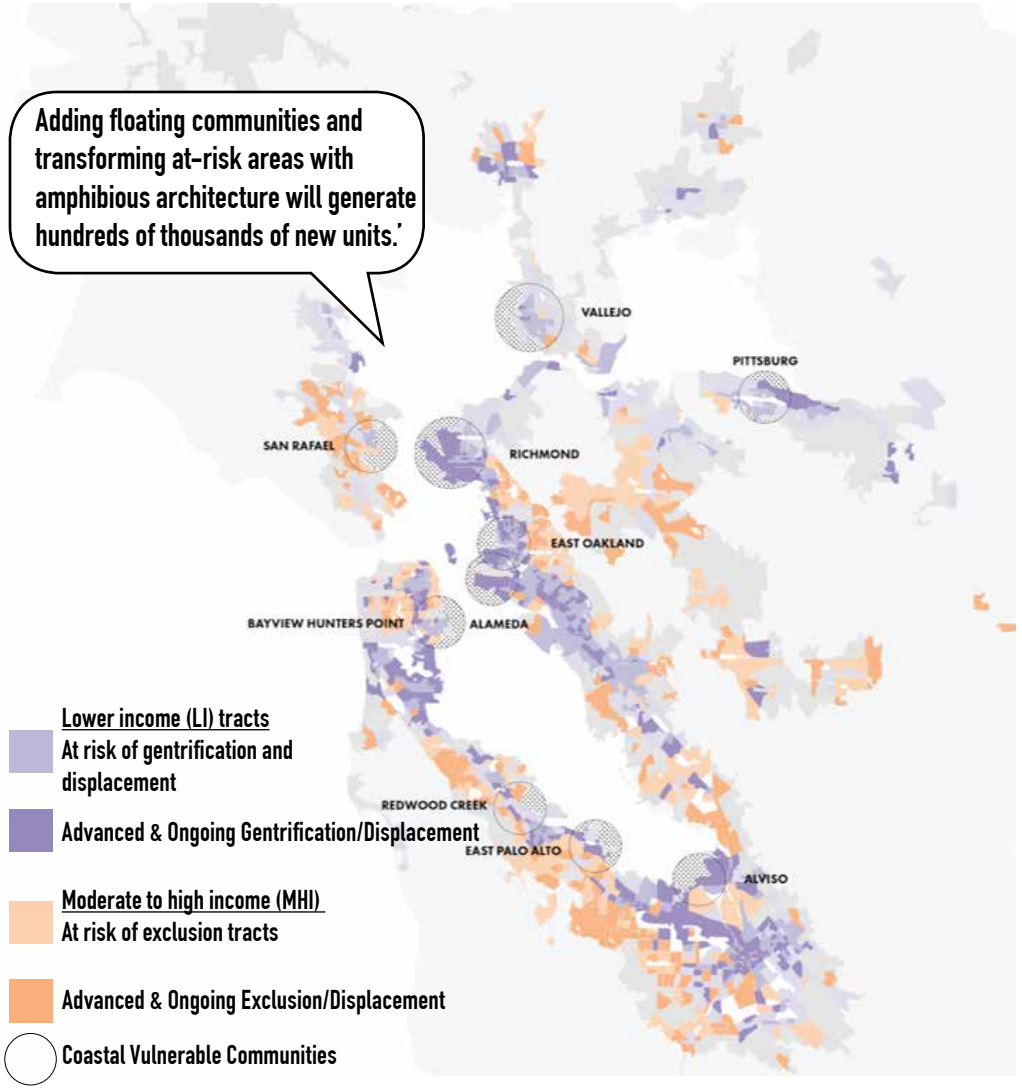


Reduced cost of resources

Collective decision making process

Use digital platforms for shared knowledge

Impact of regional applicability



Tools for inclusive design:
Participatory design tools

During the last decades, the Netherlands has experienced a shift in the way development projects are being set up and executed. The polder model – traditionally used by professionals as a method for integral (top-down) planning, has been adapted by engaged citizens interested in the quality of their living environment. The rapid growth, availability and ease of use of big data and technology enabled non-professionals to enter the scene of complex planning. The tools for inclusive quality in urban developments illustrate the methodology MVRDV has developed and successfully implemented; engaging with stakeholders, creating consensus on common visions within planning processes, ensuring the inclusion of individual needs of the users as well as the spatial and technical qualities of urban developments. We believe that these tools could help to create inclusive and resilient living environments in the Bay Area as well.

Participatory design tools

Participatory design tools support a planning and design dialogue between various stakeholders. A combination of real-life (games, polls, interviews, workshops) and online tools ensures an inclusive, human process while enabling constant and easy access to information and updates via online platforms, apps and interactive maps. Part of participatory design processes is an open-ended masterplanning approach, in which the final design is not determined before entering the stakeholder process. The designers role shifts towards defining strategies and quality guidelines, active process engagement, visualization of opportunities as well as stimulation of systems thinking. The clients role can shift towards being a moderator and facilitator of individual initiatives. The examples shown here illustrate which tools we use to support complex dialogues and collaborative decision making while keeping focus on a common, integral vision.

Initiatives and first buildings in Oosterwold

Examples in the Netherlands:

Oosterwold, Almere

- Open-ended masterplan, defining basic rules only (% greenery, position of buildings, accessiblity and energy/water supply) for sustainable development
- Users have the right/freedom to develope their dream house/office/farm/… individually or collectively
- A software assists in design, realization, construction, supplies and cost management
- Facilities are realized by the community, through crowd funding and democratic vote

Website & living map, Almere

- A website provides information for interested people and and updates for current Oosterwold community
- A living "map of initiatives" is constantly updated online, showing new developments and how they fit in with the neighbours
- The municipality has assigned a "area manager" to support inhabitants and new initiatives
- Regular workshops with the manager, old and new inhabitants to discuss new initiatives

Play the City / Play Oosterwold!

Changing the way we engage stakeholders, Play the City designs physical games as a method for collaborative decision making. Since 2010, various games have been developed for issues such as affordable housing, circular economy, migration, inner city transformation, urban expansion and participatory design.

Possible locations in the Bay Area:

The Bay Area as a whole, particularly in areas threatened by sea level rise and climate change.

Participatory design tools:

Impact on the Bay Area

Climate change adaptation benefits

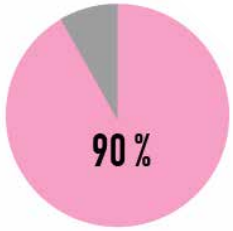
- Awareness of climate change & related problems
- Education of population on possible solutions & behavioral changes needed to adapt to climate change
- Democratic support of systematic changes
- Shared responsibility & financial burden
- Potentially faster local implementation

Other resiliency benefits

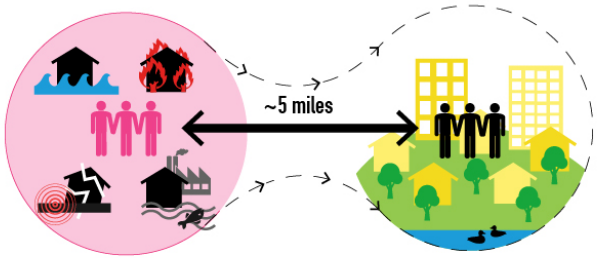
- Social cohesion
- Sense of Identity and responsibility helps on maintenance of common/public structures and spaces

Impact: Grown communities that have to find safe places have higher chances to stay vital and integrate gradually with their direct neighbours instead of having to relocate to remote places and being segregated more. A more mixed society can evolve and help to overcome inequity.

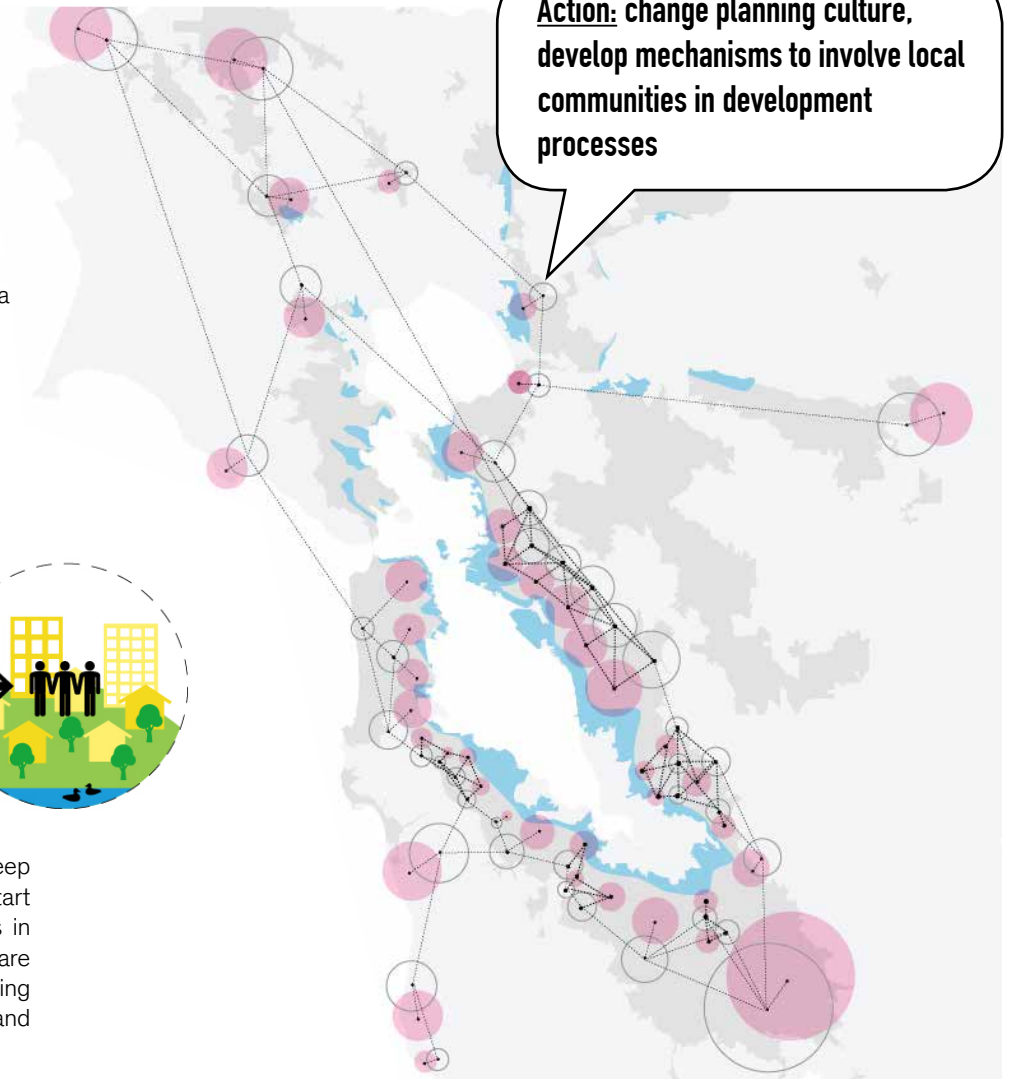
Impact of regional applicability



90% of the vulnerable communities a located within ~5miles of a saf area



In areas where retreat is unavoidable, keep grown communities together and start communication with safe communities in the direct vicinity. Like this, chances are higher that social ties of existing communities can persist. Good and intensive communication is crucial.



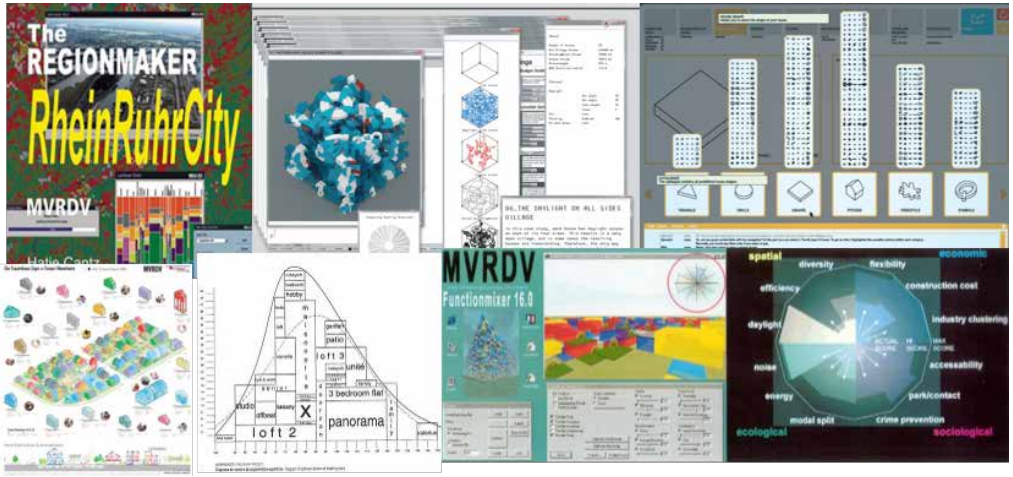
Action: change planning culture, develop mechanisms to involve local communities in development processes

Tools for inclusive design:

Compact Quality tools

Compact quality tools

How can we handle the individual desires of prospective homebuyers and users in dense urban environments? How can we translate the diversity of their identities, needs and wishes into compact and inclusive developments that form the base of a resilient urban future? In order to be able to visualize, optimize and objectively evaluate complex demands, MVRDV developed several tools to tackle this question on different urban scales. The Region maker, The Village Maker, The Function Mixer and The House Maker. These softwares can support the integration of a broad variety of individual desires, their qualitative spatial arrangement and complementory programmatic mixes. Besides softwares, we work with toolboxes of housing or urban typologies, that offer variations on spaces, customization opportunities and flexibility in function to the future users. We offer the right space to each individual and enable a housing career within the same community. This allows for a close spatial vicinity of various people with various needs and backgrounds over a long period and ultimately supports social coherence within the communities. Ultimately, these tools enable us to integrate diverse desires into very compact living environments that increase the satisfaction and social inclusion of various community members.



Regionmaker, Villagemaker, Toolboxes, House Maker, Function Mixer by MVRDV

Examples in the Netherlands:

Silodam, Amsterdam

- Part of an urban transformation and densification project in the Amsterdam harbor, with costly components (a dam with a sunken parking lot, renovation of old silo buildings, the required amount of social housing, underwater protection barrier against oil tankers, deep piling foundation and temporary drydock constructions)
- Silodam to help finance the costly operation,
- Mixed program of 157 houses (rent or sale), offices, work-spaces, commercial spaces and public spaces, arranged in a 20 meter deep and ten-story-high urban envelope
- Apartments differ in size, cost, and organization
- Phased development, a series of neighborhoods of 8 to 12 apartments were created at a time
- sequence of semi-public routes connect all the houses with the hall, the public balcony, the harbor, the barbeque area and garden, the library, fitness area and toy exchange, a three-dimensional neighborhood materializes and invites its inhabitants to interact

Markthal, Rotterdam

- Inner city mixed use development, combining various typologies of housing, market hall, retail, restaurants, supermarkets, a small museum and parking garage serving the city center
- 102 rental- & 126 sale apartments, of which 24 penthouses
- The Market hall attracts 8 billion tourists per year and forms a strong economic driver for the city of Rotterdam

The Valley, Zuidas, Amsterdam

- Part of the city's ambition to transform the Zuidas area into a more liveable and complete urban quarter
- Mix of apartments, offices, cultural facilities and commercial spaces
- The central atrium serves as both a living room for the residents as well as a Grand Foyer for all other activities in the building
- Abundance of outdoor spaces and communal green area's promotes health and well-being while contributing to the buildings green ambitions.

Possible locations in the Bay Area:

All non-vulnerable transformation and development areas in the Bay with proximity to transportation hubs. The compact quality tools are general tools that are applicable in every city. They help to create compact, socially and economically diverse urban environments

Compact Quality tools:

Impact on the Bay Area

Climate change adaptation benefits

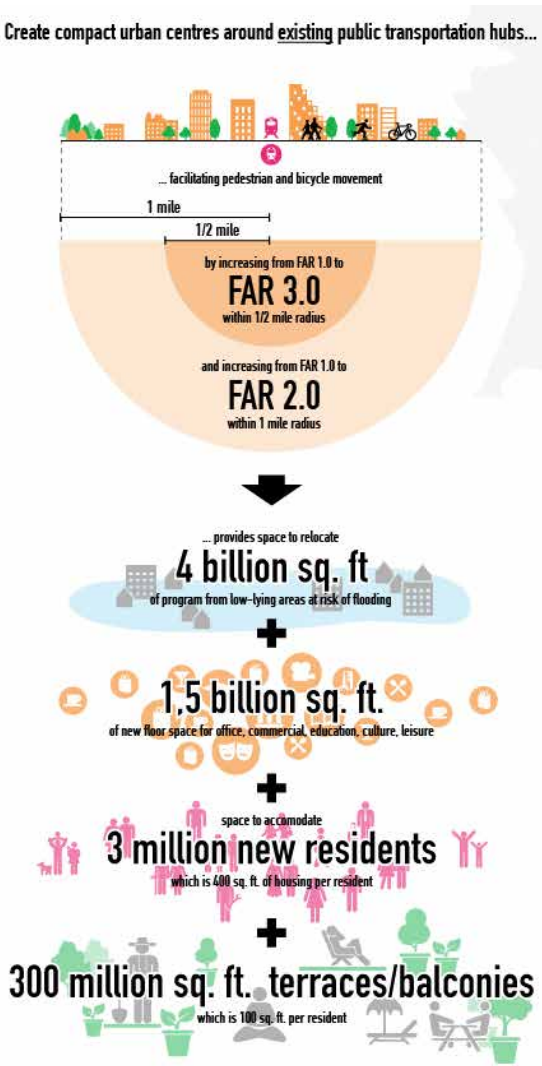
- Enough critical mass to support public upgrades
- Focus of investments
- Reduction of pollution/CO2 through walkable neighborhoods
- Concentration of population/growth in safe areas – reduction of climate change impact on safety

Other resiliency benefits

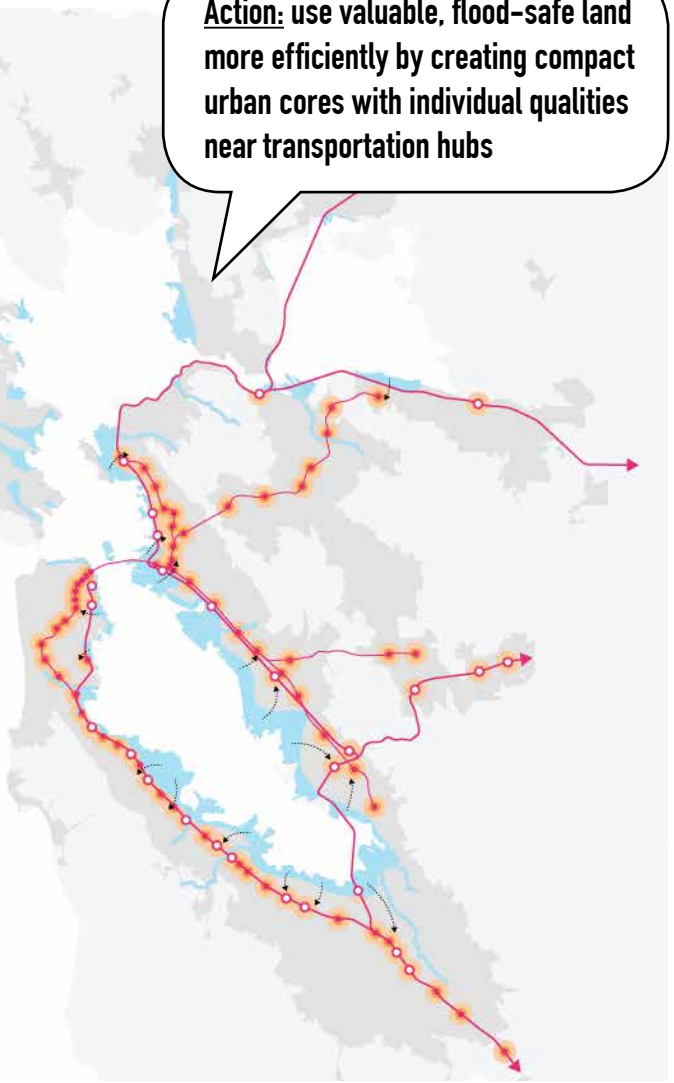
- Support individual needs & wellbeing of all users
- Less pressure on vulnerable infrastructures / reduction of traffic through mixed use
- Equality of accessibility to facilities
- Stimulation of social interaction & diversity

Impact: The expected population growth until 2040 can be hosted within existing urban fabric; in densities lower than Mission Bay, while giving every new resident 100 square feet of individual (outdoor) space!

Impact of regional applicability



Action: use valuable, flood-safe land more efficiently by creating compact urban cores with individual qualities near transportation hubs



Tools for inclusive design:

Strategic visions & scenario visualization

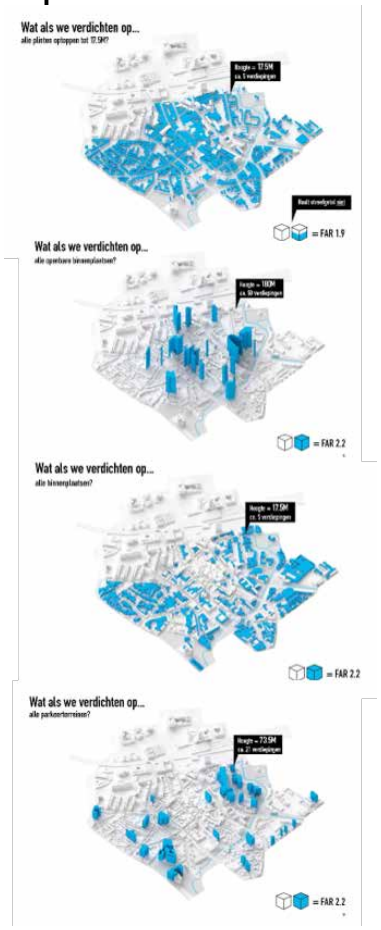
Strategic visions & scenario visualization

Strategic visions help us to define collectively supported goals, quality ambitions and thus development principles for larger (urban and rural) areas, whole regions or even the whole country. In these documents, the principle wishes for the long-term future development are described and illustrated as high-level concepts and qualities rather than fixed requirements: What sort of city/ region/country do we want to live in in the future? They leave space for interpretation but also set the overall tone and direction for all stakeholders, making sure that all individual contributions follow the same core ambition. Over a long time frame, this joint effort can lead to systematic changes needed to create these large scale ambitions and future resiliency.

In order to understand interdependencies of various fields (e.g. mobility, landscape, ecology, water, economy, sociology, urbanism, programming, etc.) and examine the potential of certain solutions, their combinations are often studied in spatial scenarios. They integrate the extensive research by various experts into spatial models, showing the “what if’s” of certain focusses or preferences for the future development. Their visualization, an easy to understand communication tool for all involved stakeholders with various backgrounds, supports the integral decision making process and the formation of a common consensus through serious dialogue.

Almere 2.0 strategic vision map

Examples in the Netherlands:



City Center, Eindhoven

- Scenario tests for urban growth – what if we densify … (all plinths, courtyards, public courtyards, parking lots, etc.)

Almere 2.0

- Dutch new town Almere plans to grow with 60,000 houses, 100,000 jobs, and all the related facilities by 2030
- The infrastructural vision for Almere describes how the city can develop in economic, cultural and social terms.
- The expansion is not a quantitative effort, , the main objective is the addition of new qualities to the area
- The growth will diversify the existing city by adding various densities, programs and characters that do not exist yet in the current situation
- The vision consists of four major development areas, each with their own character, logic and identity. These areas are connected by an infrastructural axis which also connects the metropolitan area of Amsterdam with Almere.

Possible locations in the Bay Area:

The Bay Area and its systems.

Strategic visions & scenarion visualization:

Impact on the Bay Area

Climate change adaptation benefits

- Consensus on Long-term regional goals means all smaller developments contribute to that high-level goal
- Integration various expertises is possible
- join efforts to enhance resiliency
- Visualization of scenario's important to raise awareness and show consequences of certain assumptions

Other resiliency benefits

- Forming of a vision entails serious dialogue – supports awareness & cohesion

Impact: All initiatives, top-down as well as bottom-up, pull on the same string. They each follow a clear common goal and contribute a part to the larger system; reducing double investments, and enabling systematic change on the long run.

Impact of regional applicability

Strategy 1: Transit Oriented

Water management:
Low lying areas become natural wetlands

Mobility:
Improve existing infrastructure, focus on public transportation

Vulnerable communities:
Facilitate relocation to newly densified areas

Strategy 2: Wet Feet

Water management:
Accept flooding and focus on developing elevated and floating housing

Mobility:
Focus on water based transportation

Vulnerable communities:
Facilitate relocation to water-based housing

Strategy 3: Delta Works

Water management:
A dam between San Francisco and Oakland ensures safety from sea level rising

Mobility:
Improve existing infrastructure, strengthen connections to waterfront

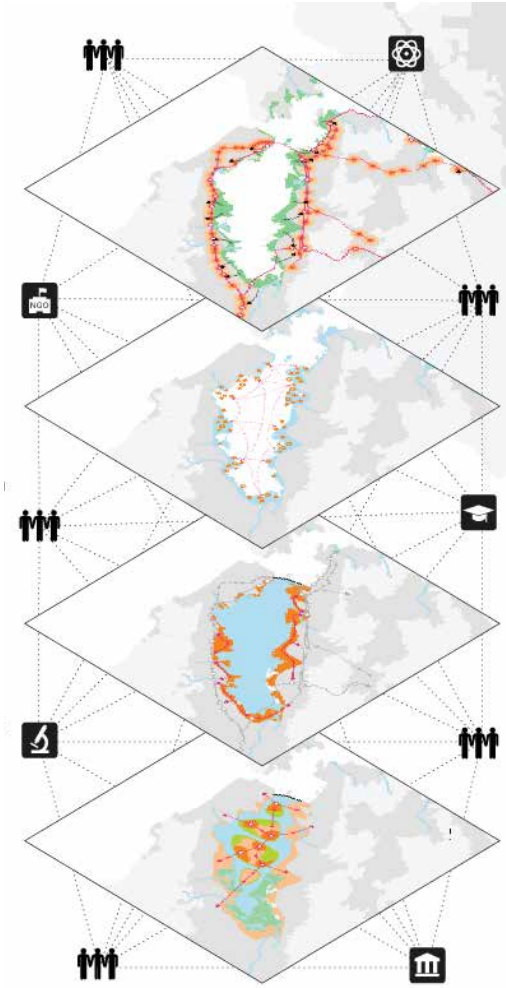
Vulnerable communities:
Affordable housing in low-lying former risk zones

Strategy 4: Polders

Water management:
A dam between San Francisco and Oakland ensures safety from sea level rising

Mobility:
Add new connections to existing transportation network

Vulnerable communities:
Polder islands provide space for a mix of intensive development and nature



After the dialog with multiple stakeholders ONE scenario must be chosen

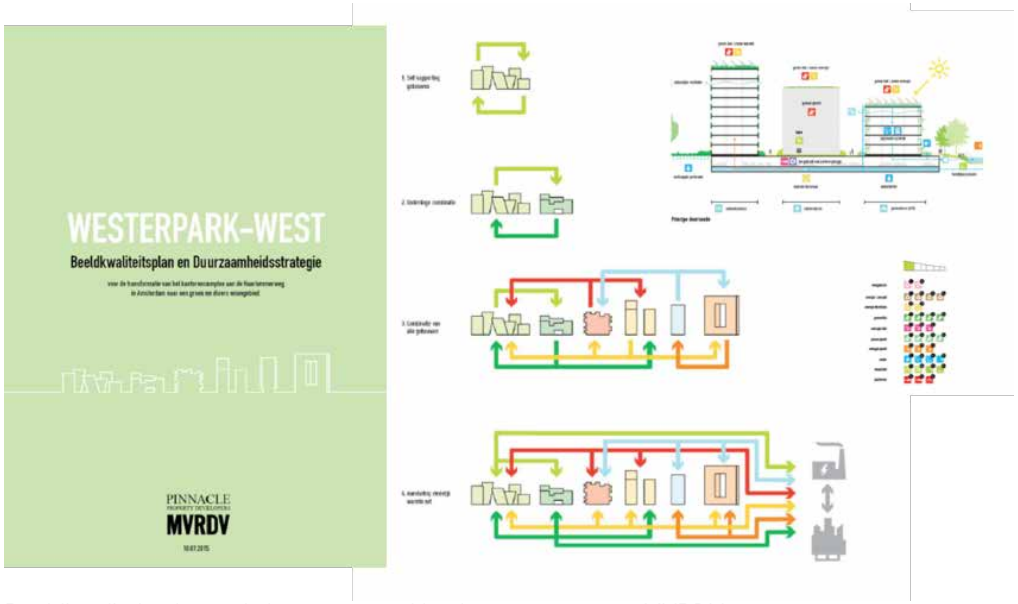
Action: join forces between all stakeholders, develop regional scenarios and define clear, common goals for the Bay future.

Tools for inclusive design:

Design quality guidelines

Design guidelines

Design guidelines ensure that larger scale ambitions, overarching development visions and systematic measures are being properly translated/supported by each initiative on the smaller scale. Mostly developed by the designers/teams of experts for municipalities, they are used as tools to steer the quality of individual development initiatives towards being a functional part of a larger vision. The total is more than the sum of its parts.
Beeldkwaliteitsplannen, administrative documents summarizing the quality guidelines for development and transformation areas, are used more and more to not only describe spatial qualities and the built expression of architecture and open space but also to define, describe and demand the integration of sustainability, mobility and resiliency measures in a beneficial way for the city or region.

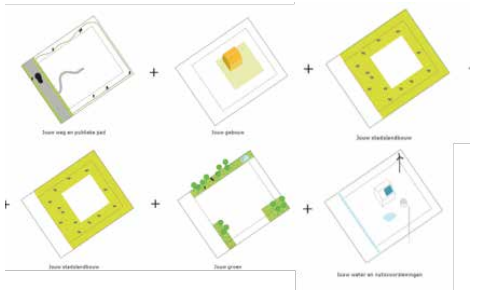


Beeldkwaliteitsplan and plot passports, Haarlemmermeerweg, MVRDV

Examples in the Netherlands:

Haarlemmermeerweg, Amsterdam

- Transformation plan for an office area; adding diversity of housing units and sustainability solutions
- Guidelines ensuring a systematic onnection of the development with the surrounding park, water system and neighborhood



Oosterwold, Almere

- By not only developing your own plot, but also all the necessary components around it, including infrastructure, energy supply, waste disposal, water storage, and public parks, you do not only build your own home, but you also contribute to the development of your neighborhood and your part of town.
- Only basic guidelines were formulated to ensure the basic collective needs like minimum accessibility, distances of buildings and sanitation safety
- Goal of the guidelines was to allow maximum individual freedom without harming the community

Hyde Park, Hoofddorp

- Urban development and transformation lanp for the desolate office park of Beukenhorst-West, located between the train station and center of Hoofddorp
- Design guidelines ensure maximum sunlight, park views for residents, while enabling maximum density
- The guidelines also describe measure how water will be treated on the plots before being fed back in the surrounding polder system. There are rules for storage, cleaning, reuse of water for each plot
- The development of Hyde Park compacts the centre and prevents the development of expansion districts, which means Haarlemmermeer can remain green

Possible locations in the Bay Area:

All safe locations for future transformation & new development

Design quality guidelines:

Impact on the Bay Area

Climate change adaptation benefits

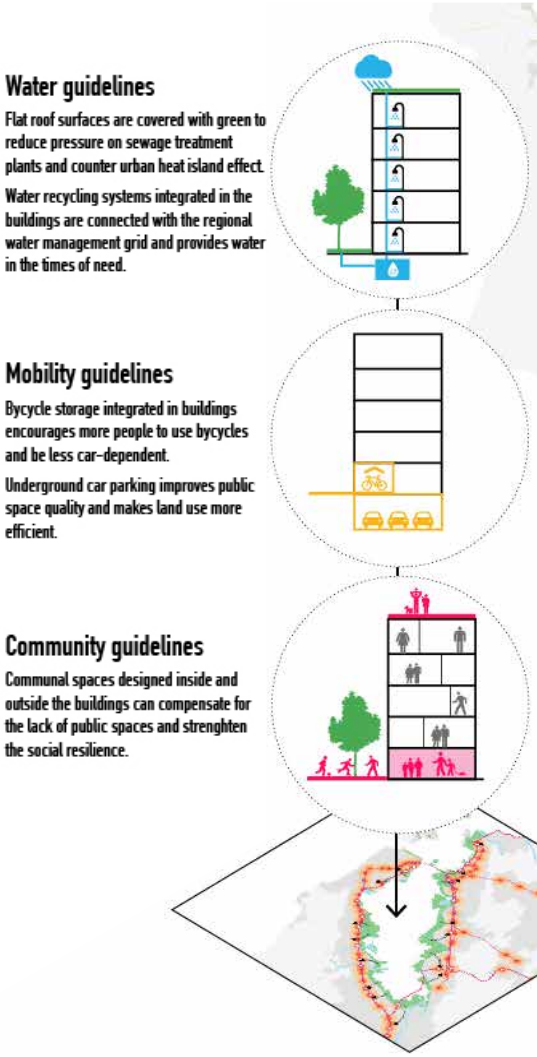
- System's resiliency through each puzzle piece
- Stimulation of local circularity to reduce impact on overall system

Other resiliency benefits

- Spatial qualities for users

Impact: Each initiative follows clear guidelines based on a common goal. Every action contributes a part to the larger system; reducing double investments, and enabling systematic change on the long run.

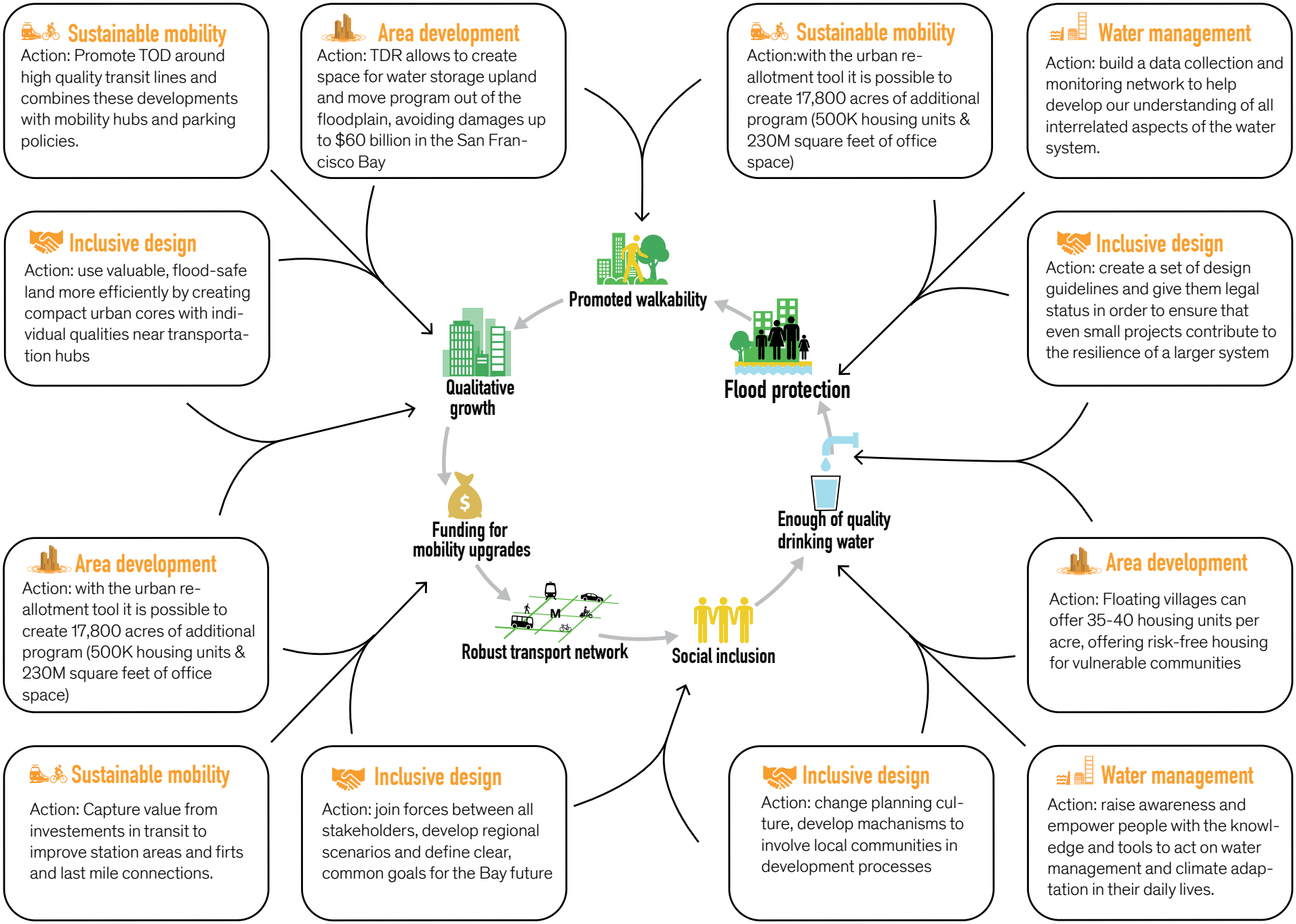
Impact of regional applicability



Action: create a set of design guidelines and give them legal status in order to ensure that even small projects contribute to the resilience of a larger system

Part 3:
Collective Actions for a resilient Bay

What all our tools have in common is an understanding that risks are best managed (and urban and ecological opportunities are best delivered upon) when a collective perspective, combined with collective action, complements the individual engagement. Effective governance requires collaboration and coordination at every level, including on the level of the overall system. Such collaboration and coordination is helped by clear science and transparent information. The visual tools that design offers greatly facilitate this process. And design helps integrate different aspects and challenges into comprehensive solutions, leading to on-the-ground examples that can be learned from, replicated or scaled.


Sustainable mobility
Action: Promote TOD around high quality transit lines and combines these developments with mobility hubs and parking policies.
Area development
Action: TDR allows to create space for water storage upland and move program out of the floodplain, avoiding damages up to $60 billion in the San Francisco Bay
Sustainable mobility
Action:with the urban re-allotment tool it is possible to create 17,800 acres of additional program (500K housing units & 230M square feet of office space)
Water management
Action: build a data collection and monitoring network to help develop our understanding of all interrelated aspects of the water system.
Inclusive design
Action: use valuable, flood-safe land more efficiently by creating compact urban cores with individual qualities near transportation hubs
Promoted walkability
Inclusive design
Action: create a set of design guidelines and give them legal status in order to ensure that even small projects contribute to the resilience of a larger system
Qualitative growth
Flood protection
Funding for mobility upgrades
Enough of quality drinking water
Area development
Action: with the urban re-allotment tool it is possible to create 17,800 acres of additional program (500K housing units & 230M square feet of office space)
Robust transport network
Social inclusion
Area development
Action: Floating villages can offer 35-40 housing units per acre, offering risk-free housing for vulnerable communities
Sustainable mobility
Action: Capture value from investements in transit to improve station areas and firts and last mile connections.
Inclusive design
Action: join forces between all stakeholders, develop regional scenarios and define clear, common goals for the Bay future
Inclusive design
Action: change planning culture, develop machanisms to involve local communities in development processes
Water management
Action: raise awareness and empower people with the knowledge and tools to act on water management and climate adaptation in their daily lives.

How can the tools be combined for maximum benefit?

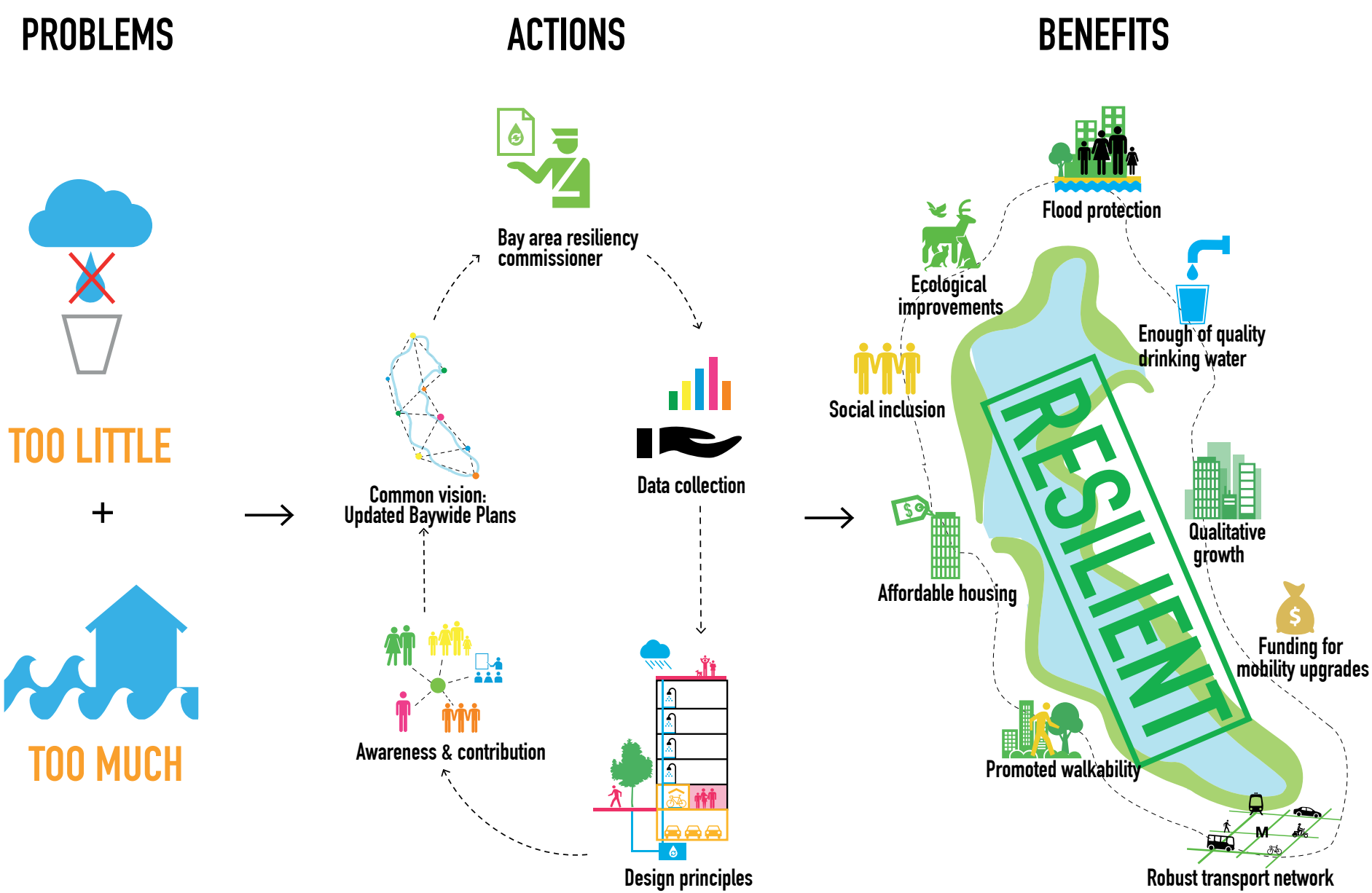
Combining tools in collective actions

The tools do not stand on their own. Effective area development goes hand in hand with inclusive design processes and effective mobility management, which in turn results in more space for water and the restoration of natural systems. The ability to use scarce land more intensively and multi-functionally and to allocate programs more appropriately makes it possible to construct more housing in more loved, healthier communities, better manage resources and reduce greenhouse gas emissions.
These potential cross-benefits can be strategically steered and maximized; turning the threat of climate change into an opportunity to tackle societal and economic challenges.

Roughly projecting the tools on the Bay Area, it becomes possible to imagine:

- Avoiding losses of tens of billion dollars, crippling the economy and keeping 270.000 residents safe from unmanaged future displacement
- Facilitating the implementation of the Resilient Bay Challenge projects while also studying larger scale measures
- A governance model that drives decision making on land-use in the coastal areas, combining strategies of:
    - Retreat from those areas where natural systems should be restored
    - Development of a 'wet feet strategy' for certain low-lying areas with floating communities
    - Protection and consolidation of program in areas that are well connected by transit.
    - The alignment of a land-use strategy with a mobility strategy that focuses on walking, biking and transit to drive a modal shift of 20% from individual cars to other modes over a 20-year period, and the development of new, mixed program around the transit nodes;
    - increasing the density around transit would generate housing for 3 million new residents, while
    - even only using the non-residential areas of the urban fabric can accommodate 500,000 new housing units and 230 million square feet of other space, allowing for healthier economic growth while relieving housing stress
    - Livable and healthy neighborhoods with an inviting public realm with ample space for urban water and collective green areas.
    - A resilient water system that reduces storm drainage, restores groundwater recharge and treats waste water such that it can be re-used for irrigation and groundwater recharge, so that groundwater pumping for drinking water is limited to emergency periods only.
    - A drastic reduction in greenhouse gas emissions and resource use
    - A culture where even small projects contribute to the resilience of a larger system, regulating water management, mobility and community assets through a set of design guidelines.

Effective, integral governance requires collaboration and coordination at every level, including on the level of the overall system.


PROBLEMS
ACTIONS
BENEFITS
TOO LITTLE
+
TOO MUCH
Bay area resiliency commissioner
Common vision: Updated Baywide Plans
Data collection
Awareness & contribution
Design principles
Flood protection
Ecological improvements
Enough of quality drinking water
Social inclusion
RESILIENT
Qualitative growth
Affordable housing
Funding for mobility upgrades
Promoted walkability
Robust transport network

What are the most important steps to take?

5 actions for a resilient Bay Area future

We hope to help with finetuning and adapting the tools such that they can work in California, starting with the following:

1. Update Plans to include water management and climate adaptation

You cannot deal with the major issues of climate adaptation, water management, housing and transport separately as this leads to suboptimal or even counterproductive strategies. Long term plans need to be upgraded and consolidated to a truly integrated plan that gives clear directions for transport and land-use strategies that support climate adaptation and water management.

2. Install a Bay Area Resiliency Commissioner

To develop the integrated plan towards resiliency and climate adaptation in the Bay Area, to facilitate open access to and sharing of relevant data and information, and to stimulate regional stakeholders to cooperate and develop adaptation pathways and strategies in line with the integrated plan it is recommended to install a Bay Area Resiliency Commissioner.

3. Understand your system – You can't manage or improve what you don't know

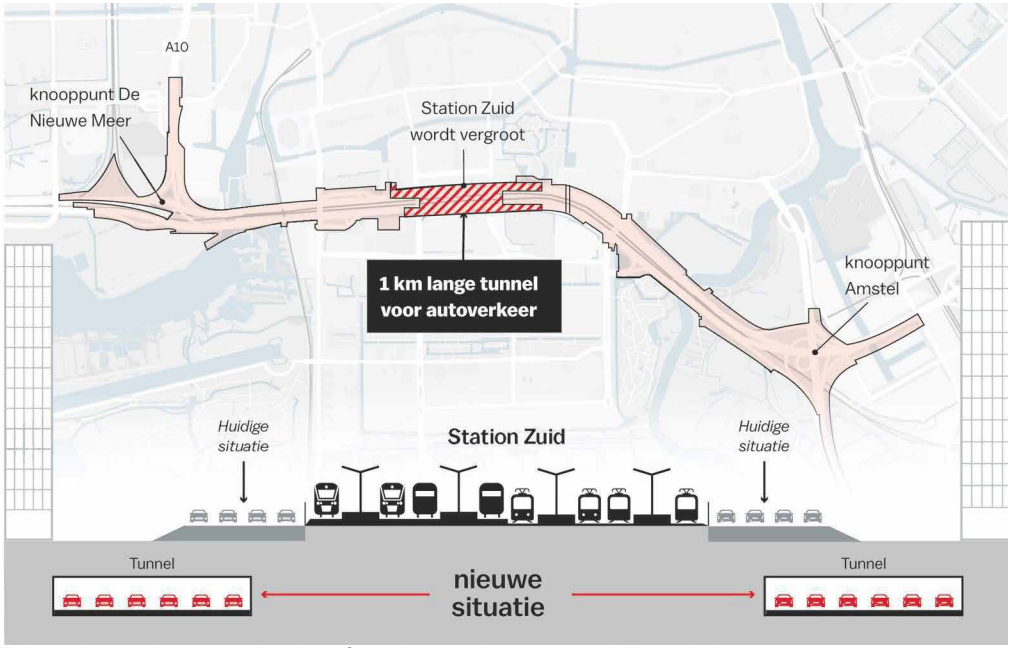
To deal with sea level rise and climate change it is important to invest in data collection and knowledge development about what is happening right now. Especially with respect to the water system there is a lot that we do not know or we do not know precise enough to develop a shared analysis of what is happening and develop effective strategies (e.g. for groundwater levels, surface water quality, discharge and pumping locations). A data collection and monitoring network needs to be set-up to help develop system understanding and monitor the effect of changes, including the implementation of adaptation strategies.

4. Collectively develop a set of design principles for local communities across the bay

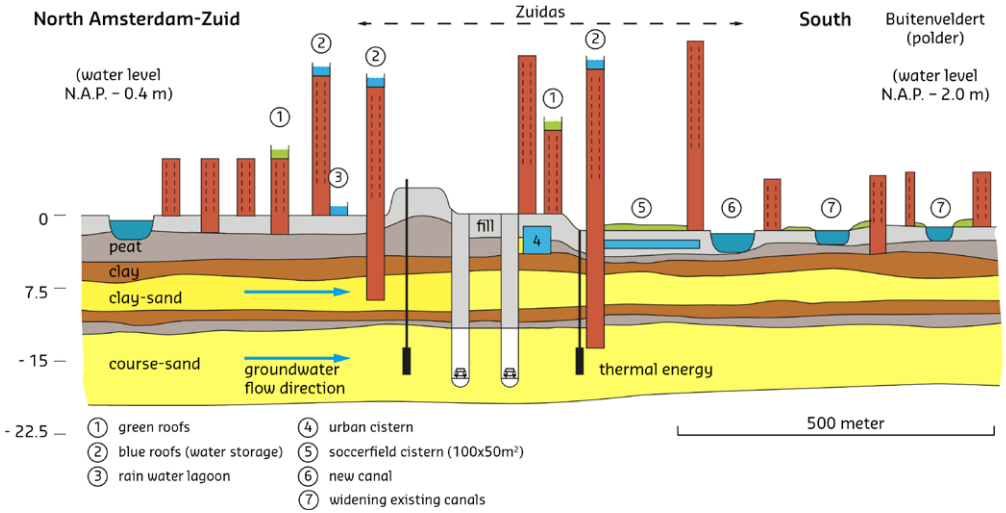
Raising awareness and empowering communities, businesses, schools and people with the knowledge and tools to act is crucial. Showing how climate change already influences daily lives today and how serious things could get in the near future will help to increase the sense of urgency. Develop a set of effective integrated design principles together with communities that show how water infiltration, green spaces, active transportation and livable neighborhoods can be tied together and how everybody can contribute.

5. Start both big and small

The huge challenges that the Bay Area faces cannot be tackled bottom-up or top-down alone. Large scale and long-term projects aimed at protecting people and infrastructure are critical for adaptation. At the same time there is a need to start implementing small solutions on local and street scale that contribute to climate adaptation, water management, active transportation and livable neighborhoods. A knowledge center should be developed to allow for the collection and sharing of (progress) data and information between academics, government, the private sector and the public.



Zuidas, Amsterdam, visualization of previous and planned mobility solutions



Zuidas, Amsterdam, water measures to enable horizontal and vertical urban densification.

Zuidas, Amsterdam, visualization of underground infrastructure

Zuidas, Amsterdam, diverse mixed use environment including public spaces and water

Examples for integral governance

In the Netherlands, a variety of governance tools has been developed that regulate and support integral planning and development processes on several levels; ensuring that what is envisioned collectively also is delivered on the ground. They form a (legal) base for serious dialogue and support the process of combining diverse expertise and tools throughout the whole planning and development process. Some examples for these integral governance tools are:

Strategic plans

Strategic plans ensure that important decision with respect to land-use, transport, water management and ecology are linked together to increase synergy, between policies and prevent counter-productive strategies. These strategic plans also give the framework for lower levels of government and other stakeholders to develop their policies.

Coordinated programs

To deliver strategies that come out of the strategic plans coordinated programs are installed with dedicated funding and involvement of all important stakeholders. Instead of letting different projects and jurisdictions compete for funding that often leads to suboptimal solutions on a larger scale the program ensures that projects that are funded reinforces each other and also allows for adaptivity to redirect funding if insights or needs change.

Design principles

Integrated planning on different geographical scales and different levels of government requires that everybody follows the same rules. It is important to have a shared set of design principles that everybody can use, wether it is a shared idea about how high the levee should be or how to design an active street and safe street with enough room for water infiltration. This principles can be improved or altered based on experiences in the field.

Control principles

To ensure that strategic plans and design principles are followed and also punt in place in local plans or private developments you have to have some control mechanisms to check if everybody is working along the lines that was agreed upon. Different governmental bodies such as the Provinces or Watermanagement Boards control the work municipalities do.

Laws

To ensure that all important environmental aspects related to spatial development and land-use are taking care of in each plan that is developed the most important planning act has recently been changed and broadened. This means that our local plan that use to be similar to zoning plans in the US now need to incorporate much more aspects related to the environment.

Examplary integral projects in the Netherlands: Zuidas, Amsterdam

The business district Zuidas, with very good connections with Amsterdam-Schiphol (airport) and Amsterdam-center, is divided by the A10 Highway and a combined railroad and metro embankment. This area is still under construction. Before (10-15 years ago) this area was mainly covered by soccer and tennis fields.
The development of the Zuidas is an example of how planning for water, transport, land-use and design comes together in a dense urban context. In the 90's the Zuidas became the prime office location in Amsterdam due to its close proximity to Schiphol Airport, highway and public transport. A new metro connection with the city center and the arrival of the high-speed train from France would make the area even more attractive. To prevent the area of becoming a monofunctional business district an ambitious master plan was designed to develop a new mixed-use urban center with high quality urban spaces.

One of the key aspects of the plan was to put the highway into a tunnel. This made it possible to heal the urban fabric and add housing to the area.
During the design and constructing of this very dense urban district a lot of effort was put in managing storm drainage. An extra challenge herewith, is the planned activity to deepen the highway underground, into 2 separate 10-15 deep tunnels. This activity creates space over ground to develop additional buildings in the center of this business area, connecting the center of Amsterdam with the economically important Airport Area in the south.

In the illustration on the left, the water management activities needed to facilitate the functionality of the tunnels and water system are summarized: (1) adding green roofs, (2) adding blue roofs with small weirs to delay storm drainage, (3) collect office (EY) storm drainage in ponds and re-use collected water in the building, (4) creating an underground cistern near the station, (5) construct a 50 × 100 meter wide cistern below a soccer field, (6) construct a new canal (De Boele gracht) creating extra storage and improving the urban quality, (7) widen existing canals in the adjacent existing urban area (Buitenveldert polder) to create additional storage.
Most of these new offices make use of (shallow) thermal energy: Energy neutral circulation of cold and warm water, making use of heat pumps. This area also makes use of an collective underground (shallow)tunnel for all cables, conduits etc.

The NL Resiliency collective can support your steps towards a resilient Bay future. We can offer a diversity of expertise and global experience in integral, systematic solutions:

Deltares

Deltares is an independent institute for applied research in the field of water, subsurface and infrastructure. Throughout the world, we work on smart solutions, innovations and applications for people, environment and society. Our main focus is on deltas, coastal regions, river basins and cities. We work closely with governments, businesses, other research institutes and universities at home and abroad. Deltares' areas of expertise include: Climate resilience, Adaptive planning, Urban water management, Urban engineering, Critical infrastructure, Subsidence, Integrated water resources management, Flood risk analysis and flood risk management, Operational warning and management.

Deltares aims to support urbanizing deltas around the world to become more resilient to physical, social, and economic challenges. We specifically focus on working on the water- and subsurface layer of the urban ecosystem. We seek ways to mitigate risks and realize the potentials of urban areas, allowing for sustainable, inclusive and climate-robust development that contribute to the quality of urban planning and design. By integrating local with expert scientific knowledge, we develop adaptive, integral and innovative strategies and planning tools for urbanizing deltas all over the world.

Deltares employs over 800 people and is based in Delft and Utrecht in the Netherlands. Deltares has offices and affiliates in Singapore, Indonesia, Australia, Abu Dhabi, Latin America and the USA.

www.deltares.nl

Credits: Roelof Stuurman, Henriëtte Otter, with input from many colleagues.

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mobility consultants
Goudappel Coffeng

EXCELLENT CITIES
Urban Mobility Experts

Goudappel Coffeng:
Improving urban performance by mobility

Our mission is to use proven Dutch mobility solutions to create sustainable, accessible, liveabale and economic flourishing cities worldwide.

Integrated network design creates attractive vital cities, to better use scarce space. Dutch cities are famous for their high quality of life, including their smart mobility systems. As a world-wide strategist for urban mobility, Goudappel aligns city goals and mobility plans for both long term, as well as for tomorrow. For more than 50 years, we are the leading firm on mobility engineering in The Netherlands. Our core business focusses on redesigning the mobility architecture of existing cities and make these cities adaptable for changing demand within their existing space. Shortly, we are experts in projects that deal with growth in cars and populations, with all kinds of solutions for network management, public transport, parking, cycling and pedestrians.

Our role in projects that improve urban performance is twofold. First, we inspire and sharpen interventions with strategic workshops, concept studies or second opinions. Using the MoveMeter, a powerful IT-tool that generates data for decision-making. Second, during implementation of the plan, we typically are the 'back office' for local partners for quality assurance and knowledge transfer on Dutch experience.

Goudappel Coffeng is part of the Goudappel Group (300 mobility professionals), consisting of multiple companies that work together on improving urban performance by mobility. The Group's best-known labels are Goudappel Coffeng (www.goudappel.nl) and DAT.Mobility (www.dat.nl).

'Excellent Cities' is our international program (www.excellent-cities.com) in which we partner with universities, local partners and cities.

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MVRDV

MVRDV

MVRDV was set up in 1993 in Rotterdam, The Netherlands by Winy Maas, Jacob van Rijs and Nathalie de Vries. MVRDV engages globally in providing solutions to contemporary architectural and urban issues. A research based and highly collaborative design method engages experts from all fields, clients and stakeholders in the creative process. The results are exemplary and outspoken buildings, urban plans, studies and objects, which enable our cities and landscapes to develop towards a better future.
The work of MVRDV is exhibited and published worldwide and has received numerous international awards. 150 architects, designers and other staff develop projects in a multi-disciplinary, collaborative design process which involves rigorous technical and creative investigation.
Together with Delft University of Technology, MVRDV runs The Why Factory, an independent think tank and research institute providing an agenda for architecture and urbanism by envisioning the city of the future.

www.mvrdv.nl

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●ne architecture

One Architecture

One Architecture & Urbanism (ONE) is an award-winning design and planning firm with offices in Amsterdam and New York. Established in 1995, the firm is known for its unique approach in which financial, technical, and organizational issues are addressed and resolved through design.
A key area of ONE's expertise is large-scale resilience planning and infrastructure. The office works on flagship resilience projects in New York, Boston and San Francisco. A co-leader of the BIG Team that won the Rebuild by Design competition for the flood protection of Manhattan, ONE is currently part of the multi-disciplinary teams executing the first phases. Under the leadership of founding principal Matthijs Bouw, ONE has been instrumental in the development of complex, multi-actor planning processes across the globe. Through extensive and experimental stakeholder and community interfacing, ONE has pioneered the concept of "engagement by design." In their studios, designers work with engineers, policymakers, and communities to shape joint narratives.

www.onearchitecture.nl

Credits: Matthijs Bouw, Despo Thoma, with thanks to Gerwin Hop and Co Verdaas (OverMorgen) for their input.

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Kingdom of the Netherlands

The Consulate General of the Kingdom of the Netherlands in San Francisco is proud to be a partner in this project. The Netherlands is committed to helping countries and cities worldwide prepare for rising sea levels. The Consulate General in San Francisco connects the Netherlands and the Western States of the USA. We bring American institutions, communities and businesses together with Dutch experts to find solutions for water-related challenges. To that end, we work closely with the Netherlands' envoy for Water Affairs, Henk Ovink, Dutch companies and research institutes with expertise in water management. We have organized fact finding missions on resiliency and water management to the Netherlands, and brought Dutch business delegations to California and the Bay Area.

Learn more at www.NLintheUSA.com.

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NL Resilience Collective

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Deltares Enabling Delta Life

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