94th congress of ASTEE

2-5 June 2015 - MONTAUBAN (fr)

PRUDENT & PROTECTIVE TOWNS AND TERRITORIES

How Municipal Services Rise to the Challenge

INTRODUCTORY BOOK

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How Municipal Services Rise to the Challenge

Work directed by Nicolas Gendreau and Marcel Belliot

Editorial secretariat: Carine Morin-Batut, Lucile Mauranne, and Marie Thibault

Graphic design: id bleue - www.idbleue.com • Traduction: ITC Traduction

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Foreword

By Pierre-Alain Roche,
President of ASTEE

In 2010 we began our series of inter-disciplinary, introductory works for our annual ASTEE congresses, for which they set the tone and guiding ideas: changes in our professions, the performance and governance of services, the alliance between public services and urban planning, innovation, this year's theme of "prudent and protected towns and territories" and 2016's theme, already in preparation, "smart cities".

A crossroad of viewpoints from elected officials, researchers, particularly from the human sciences, practitioners, and citizens, these works are prepared with a healthy sense of urgency intended to mobilise efforts and promote goodwill. This year, we owe this highly thoughtful collective production to the dynamic and enthusiastic guidance of Nicolas Gendreau and Marcel Belliot, along with the effective support of Lucile Mauranne, who then passed the baton to Marie Thibault. I would like to thank everyone for their commitment.

The theme, "prudent and protected towns and territories", was not chosen right away: we quickly realised that our first idea, "resilient and smart cities", would be best addressed separately, at two different congresses, to properly cover each topic. We then decided to drop the word 'resilient' from the title, though the concept is present, dissected and analysed on every page of this work. But we like simple words. We wanted to join in discussing some of the concerns being raised at the COP 21 (UN Climate change conference), without being "one more" 2015 colloquium on climate change: "prudence" allows us to approach it from the angle of conservation and mitigation, and "safety and protection" from the angle of adaptation. As one cannot discuss "sober and safe cities" without mentioning scale interactions, solidarity between cities, suburban areas and rural areas, short circuits, relocation, and the circular economy, we decided to add "territories". In the end all we needed was two nouns, two adjectives, and two coordinating conjunctions to express it all: this brevity is a tribute to prudence. In French, the words give us one foot too many for an alexandrine, but nothing is perfect.

Does putting these keywords side-by-side constitute "a theme"? Were we right to pair towns and territories, prudence and protection? Upon reading this work, the answer is clearly yes. Prudence, increasing resilience, and territorial integration are today's pressing issues: do they go together naturally or are they divergent lines of thought that should be reconciled? The convergences and divergences of the many needs that practitioners must help find answers for, these are the questions our authors tackle.

Our modest "factory" continues the thinking we had undertaken on urban planning and urban services; ASTEE now has a specific task force to lead ongoing work on these issues. We understand that complexity is now a given, that the city is regarded as a system, and that the expected benefits of an innovation are no longer considered without first looking into its effects on all levels, with regard to all the aspects of urban quality we look for. Abandoning destructive simplifications does not mean renouncing action by getting caught up in doubt, but rather acting based on full knowledge of the facts, aware of all potential effects and feedback. Highlighting risks and preparing to manage crises and their aftermath does not entail giving in to safety paranoia or the victimhood of a hypochondriac society, it simply means putting priorities back in order with a lucidity and pragmatism that is often lacking. Finding ways to save and streamline the profusion of goods and public services does not mean impoverishing them or ripping them out of the social fabric, it means reconstructing it by reflecting upon the situation fairly and sharing these findings by trimming away unnecessary expenditures. Forming a bond with the territory is not about dreaming nostalgically of the bygone days of rural France, nor forgetting the strategic advantages of urbanisation, it is simply understanding that close bonds are simple, direct and effective if we take care not to forget about them.

Our energy is devoted to learning and cooperation, and to the integrative and inclusive territory project. It is unpretentious, flexible and adaptable, constantly asking new questions, serious to the point of austerity and friendly to the point of fantasy. It comes from people... and speaks with people.

A word of welcome from the Adour-Garonne Water Agency

Reducing pollution, securing the drinking water supply and preserving aquatic environments, encouraging the incorporation of research and innovation in public decision-making, and supporting good initiatives while integrating different users' needs, these are the missions of the Water Agencies created in the 60s to manage water, the nation's common heritage, and, more recently, aquatic environments.

In this context, the Adour-Garonne Water Agency, which acts as the secretariat of the basin committee's scientific council, carried out the Garonne 2050 prospective study, which will help guide its future. This experimental collective approach aimed to anticipate future challenges such as global warming, both with regard to the basin and on a more local scale. Mitigating its effects, including locally in the water sector, may prove to be energy intensive. We must be able to anticipate how to adapt, that is to say, act rather than stand idly by. From this angle, water and aquatic environments will become strategic factors in the years to come, in a basin where the climate is getting warmer and undoubtedly drier.

Faced with these developments, we must take into account the characteristics of the Adour-Garonne basin, which has both strong agricultural activity and areas that are urbanizing quickly. Today it has 7 million inhabitants (and another 3 million in season) and around forty cities with over 20,000 residents. INSEE forecasts that more than one and a half million additional people will arrive by 2050. The greatest migration attractiveness will be generated by the large city areas where most industrial jobs are today: aeronautics, automotive, equipment manufacturing, as well as the food and chemistry industries.

Across the basin, the drinking water supply system relies on over 6,000 catchments and 190,000 km of distribution networks. Drinking water is, and shall remain, a priority utility that is now provided in quantity and quality to every inhabitant of the basin. The Garonne 2050 study hypothesises that the increase in demand, caused by the increase in population, will be offset by a decrease in individual consumption. What will really happen? Which water conservation methods should be implemented when striving to make drinking water usage more efficient? How can we ensure a reliable, quality source of tap water when dealing with emerging and diffuse pollution?

With regard to the "sanitation" aspect, the basin has 40,000 km of networks and 4,600 water treatment plants. It is important to anticipate that these assets will require renewal and that they must be kept well-maintained. Pollution from discarding household and industrial waste in rivers is generally well contained thanks to substantial clean-up efforts, community efforts in particular. However, collective sanitation systems continue to contribute to the declassification of about 40% of the water bodies said to be in poor condition. How will climate change and the growing population affect the future? This question comes up both in dry weather conditions as well as during rainy periods when direct discharges are common, despite the significant presence of separated sanitary networks. In the future, water flow could increasingly become the limiting factor for the dilution of discharges. There are technical solutions, such as improving the performance of purifying tools, moving discharge points to increase dilution, limiting discharges during periods with low water levels, and replenishing rivers for health safety reasons. As for the micropollutant problem, research into substance substitution and reducing micropollutants at their sources should be top priorities. But what will be the limitations of this reduction? If a treatment is to be considered, it must not generate compounds that are more toxic to health and the environment. In broader terms, the financial and energetic costs of sanitation are significant, and prudence is a quality that should be sought. Future studies should aim to find good ways to strike a balance between prudence and protection.

With regard to water integration in urban planning projects, the fight against urban sprawl has become

a priority in documents such as the SCOT (territorial coherence plan) and PLU (local urban planning scheme), aiming to avoid having to invest heavily in networks. Cities must manage storm water and combat soil sealing to reduce both pollution in rainy periods and the risk of flooding due to runoff. This is the mindset of the eco-neighbourhoods that strive to preserve natural resources and support efficient resource management. Cities must also fight against the disappearance of agricultural zones and have greater respect for the functional areas of aquatic spaces by preserving or restoring flood expansion areas, wetlands, and other areas through which water travels. While the "trames vertes et bleues" (the 'green and blue framework', a French programme and conservation network) aims to preserve biodiversity, it also created a boom for recreational and landscape services and contributes to making cities greener, helping to combat the heat islands that our urban centres have come to expect in summer.

In anticipation of the major international forums of 2015 — the World Water Forum in Korea in April and the Paris Climate Conference (COP 21) in France in December — the Water Agency and ASTEE must take part in these discussions and initiatives, alongside those who are devising the solutions of the future.

Laurent Bergeot, General Director of the Adour-Garonne Water Agency

Photo: H. Ressayres

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General introduction

Prudence and protection, two necessities of a "sustainable city"

Humanity has but one Earth, and we live on a planet whose natural resources are not inexhaustible. This is a relatively recent realisation. This perception started to emerge in the 70s, and the "Earth Summits" in Rio de Janeiro in 1992 and 2012 were major milestones. COP 21, the United Nations Conference on Climate Change to be held in Paris in December 2015, will further this cause by highlighting the risks that human activities pose to the planet's equilibria and the danger they cause in terms of destruction of ecosystems... Mankind is no longer totally free of blame for the disasters it experiences. New risks have arisen — climatic, industrial, health — that are not the easiest to resolve... In a "finished" world that is fraught with pitfalls, mankind must face some very serious challenges.

The big challenges

The first of these challenges is population growth and the pressure that this puts on the planet's resources. Earth had 10 million inhabitants ten thousand years ago, at the beginning of the Neolithic period. It had 200 million three centuries ago. Today there are over 7 billion people on Earth, and by 2050 there may be over 10 billion. **How will we deal with the enormous demand for primary resources caused by this population influx?**

The second challenge is urbanisation. In 1900, 13% of the world's population, 1.8 billion people at the time, lived in cities. Today, half the world's population lives in cities, and this figure may reach 60% by 2050. This means cities will have to find ways to accommodate an additional 2.5 billion people in the next 40 years. **How can we deal with the massive need for space, living areas, activities, and services that this growth will create?**

The final challenge is the climate, which is largely linked to the uncontrolled use of fossil fuels. This has multiple effects. Climate change alters rainfall and can give rise to deserts. It causes natural disasters and disrupts the balance of the seasons. Lastly, it affects the sea level, and if drastic measures are not taken, soon cities and whole territories will need to be abandoned, or will become unfit for habitation.

In this uncertain context, the need for prudence and protection will become vital. **We will need to manage the resources necessary for life as closely as possible** to ensure that cities run well. We will need to **anticipate natural and man-made risks** that could make life impossible. How can municipal services adapt to this new situation and address these issues?

The challenge of "prudence"

In terms of prudence, a quick step backward would undoubtedly be useful. The profound paradigm shift that occurred in the middle of the last century, when modern municipal services were set up in all the developed cities in the world, should be stressed. An economy based on scarcity and recycling was effectively replaced by an economy based on abundance and waste. The generalization of running water and the establishment of combined sewer systems have condemned the old systems for recovering and recycling waste water and human excreta. Improvements to living standards and the triumph of the "consumer society" have significantly increased the production of waste and multiplied the production of objects doomed to planned obsolescence. In a world where resources were considered inexhaustible, why save and recycle? We moved from a highly intensive exploitation of municipal services oriented towards recovery to highly extensive methods of waste management where the technical processes themselves rule out any possibility of recycling. The only "way out" for effluents and municipal waste was to be discarded into nature in huge quantities. This resulted in considerable damage to both the natural environment and to cities. All the industrial and urban waste has accumulated there, in volumes and quantities that the environment could not possibly absorb. We have just barely moved on from a crazy period of history when the euphoria of economic growth and the illusion of a natural environment with infinite healing powers have led to an ever increasing, uncontrolled spread of pollution inside and outside of cities.

Once again a cardinal virtue, the need for prudence has prompted pre-emptive action focussing on modes of economic production and consumption circuits. This leads to establishing processes and organisational systems for municipal services that promote recycling, recovery and reclamation.

A "sustainable city" will never be a self-sustaining city. Cities need an outside world in order to thrive and function. With globalization, this "outside" can sometimes be very far away, providing everything from foodstuffs and consumer items to recycling loops and disposal sites. Cities must continually choose between mobilising the resources they need to operate and protecting the natural environments and ecosystems in their hinterlands. How can we reconcile cities' activities and need for living space with the needs of the resource areas that sustain them? What are the possible partnerships, synergies and interdependencies between territories? Territorial governance plans and methods for organising municipal services should be "revisited" if we are to ensure prudence at every level...

The two previous ASTEE Congresses, dedicated to urban planning in Nantes in 2012 and to innovation in Orleans in 2013, laid the groundwork for many leads. In a "prudent town," municipal services must be designed and managed in close conjunction with urbanization policies and take advantage of technological progress. This introductory work features a number of illustrations of this dual requirement of transversality and innovation.

The challenge of "protection"

Cities, long established to bring people together and defend them against attack, are now under threat. Today they are home to half of the world's population, and tomorrow they will be home to two thirds. Their sometimes extreme density can become problematic, as the forced close quarters in urban neighbourhoods result in significant health risks, fostering the dissemination and proliferation of diseases and epidemics. Often situated along rivers and shorelines, cities will be the first affected by the consequences of global warming: cataclysmic events, rising sea levels... Natural phenomena, however, are only some of the dangers that cities will need to address. Man-made disasters can be just as destructive, disrupting or jeopardizing their ability to operate: wars, industrial disasters and health disasters... The public services that ensure a city's needs for water, energy, sanitation and waste management are met form the framework of urban life. They are the lifeblood of 21st century cities and without them societies as we know them could not exist. However, they pay a price for their extreme

utility: they are also the "weak link" and preferred channel for the spread of crises and disorders. Making them safe and restoring them are top priorities after a "disaster". Key to cities' resilience, they are vital to restarting urban life. We must focus on how cities can be designed to withstand natural disasters, and then regain their footing afterwards.

How can municipal services improve protection and prudence for cities? Can they all do so to the same degree... and can they do it at the same time? Are the goals of prudence and protection complementary or conflicting? Should we be talking about "prudent AND protected towns and territories" or "prudent OR protected towns and territories"? These questions are central to the contributions collected in this work and will be discussed at the 94th ASTEE Congress, held in Montauban in June 2015 under the title "*Prudent and protected towns and territories, public water and environment services rise to the challenge*."

The introductory work of the Montauban Congress is a collection of twenty-three submissions, viewpoints, accounts and recollections from elected officials and experts, designers and technicians, operators and managers. By gathering a diverse range of views expressed by contributors with an equally diverse range of responsibilities, it sketches out a 'road map' on how municipal services will support and strengthen the municipal policies of prudence and protection in the future. It is divided into three main parts:

- The first is an analysis of the interrelated issues of prudence and protection in the field of municipal services.
- The second is about risks and how municipal services contribute to municipal resilience policies.
- The third focuses on the role users play in enhancing the protection and prudence of municipal services.

Drawing up a "situational analysis and knowledge inventory" on the problems of protection and prudence in municipal services, this work serves as an introduction to the subjects that will be discussed at the Congress.

CHAPTER 1:

THE CHALLENGES OF PRUDENCE AND PROTECTION FOR MUNICIPAL SERVICES

Municipal service networks give structure to conurbations and support their development. Cities' economic productivity, the ecological footprint that affects them and their ability to respond to crises and accidents are heavily dependent on the design and operation of municipal services. At a time when the challenges of prudence and protection have become critical, the way in which municipal services address these issues will determine whether the towns they serve can be sustainable.

Sabine Barles recalls that this double challenge has always guided the government's actions... but that social and economic conditions have led to different decisions. Far from the hygiene movement of the nineteenth century, developed in a society rife with health risks and resource shortages, the consumer society of the twentieth century is characterised by abundance replacing scarcity, where the networks supplanted service and where 'waste' of resources became 'refuse'... Questioning the current organization of network services, she highlights the limitations of an urban metabolism that is too outsourced and advocates returning to a more circular and more efficient metabolism of the territory's resources. Cities need "urban engineering" more than ever...

→ p.19

The example of the Syndicat des eaux d'Ile de France (SEDIF, the Ile-de-France regional water authority), presented by Véronique Heim, illustrates the virtues of a tightly controlled, centralised system. Serving 4.4 million people each day by exploiting a primarily fluvial resource in a highly urbanized environment, while also dealing with numerous pollutants, is a truly impressive feat. SEDIF accomplishes this by employing multiple security measures, interconnecting its network, and carefully protecting its catchment units and water treatment plants. The digital tools that will place consumers at the heart of the service in the future will make it easier to manage this centralised system.

→ p.22

Complementary to the previous case, the example of the Paris urban area interdepartmental wastewater treatment authority (SIAAP) illustrates the magnitude and complexity of the problems facing the authorities in charge of sanitation for eight million Paris area residents. Land scarcity and the encroaching proximity of urbanised areas forces treatment plants to be compact and follow stringent safety precautions. The increasing cost of energy has led to making water treatment plants from energy production centres. The entire economy of the sanitation sector will emerge transformed.

→ p.29

There is more to wastewater treatment than its technical and health dimensions. It is also part of the "small water cycle", and as such it can make a valuable contribution to the resorption of water imbalances that some areas face. Sarah Hercule-Bobroff, Christine Gandouin and Boris David demonstrate this in their article on reusing treated wastewater ("RTW"). Supported by the European Commission, this technique is developed in regions that experience water stress. It makes it possible to recycle a scarce resource, which benefits agriculture and, can contribute directly to the drinking water system.

→ p.34

The progress made in the last century with regard to resorption and disposal of urban waste is also considerable, as shown in the article by Dominique Pin. Waste production has increased exponentially since the last war. At the same time that plant safety regulations were becoming increasingly stringent, very active policies for recovering and recycling waste were implemented by the government. The day when yesterday's landfills become tomorrow's *urban mining* sites is not that far off…

→ p.37

A good example of this 21st century sanitation is the *Louis Fargue* treatment plant in Bordeaux, presented by Pascal Botzung and Francis Lamarque. This treatment unit, located at the heart of a new district in Bordeaux, recently underwent a complete overhaul to get it up to standards. Conducted as a cooperative effort with local residents and striving to achieve a design that is integrated into the urban landscape, this renovation has led to the recovery of a significant amount of energy. In addition, an action plan was made to limit risks and reassure local residents. After *Louis Fargue*, maintaining a treatment plant in the city no longer seems like a fantasy…

→ p.41

As Thierry Mauban confirms in his article on waste as an indicator of efficiency in a circular economy, waste recycling is not just a technical matter. It also fits into a social and economic context and is part of a 'production - consumption - abandonment' chain. Thierry Mauban favours waste prevention and implementing alternatives to production and consumption, limiting waste, and promoting the reuse and sharing of certain goods. Usage rather than ownership, sharing rather than individualism... A cultural change is taking place...

p.45

Jean-Pierre Turon, the Mayor of Bassens, a Bordeaux suburb, is "lucky" to play host to over 25 listed establishments in his commune's territory. Beyond the issue of security itself, which is generally well controlled, auditory, olfactory, and visual "nuisances" make up the locals' main bone of contention. The identity and wealth of the commune are, however, closely linked to its industrial vocation, and this has long been enough to appease citizens' concerns. Now we must go further. From this point of view, facilities' innovative character and architectural quality contribute greatly to projects being accepted. Industrial beauty is possible!

p.47

For Gérard Poujade, Mayor of Le Séquestre, "Agenda 21"-type approaches are excellent instruments for implementing local policies for sustainable development. They help mobilise residents to support environmental protection objectives, resource saving, and territorial solidarity. A first "Agenda 21" plan was approved in 2005 and a second, more ambitious one was launched after the 2014 municipal elections. It provides a variety of ways to save energy, limit CO_2 emissions, recycle waste, and fix prices for water consumption differently. Based on subsidiarity, it proposes actions that can be undertaken and completed locally, directly engaging residents.

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The city of Grenoble plans to launch a major development project in the ZAC de la Presqu'île (an urban development zone), and several actions involved with this project are part of the "City of Tomorrow" investment programme. Vincent Fristot, deputy mayor of Grenoble, presents a few. These actions include making housing insulation 30% more efficient than the thermal regulation standards in force through insulation and mobilising groundwater, reducing light pollution from street lights, installing multi-fluid "smart" meters, and reducing the energy consumed by mobility services: tramway, cycling, etc. The neighbourhood's future residents are extensively involved in the process.

p.55

The Garonne 2050 prospective study, conducted by the Adour-Garonne Water Agency, offers a new vision of the territory, discussing water and resource needs in the context of projections about the climate, population, energy, and agriculture. It combines scenarios, created in participatory workshops, with an effect quantification phase. The factor with the greatest impact on hydrology is undoubtedly climate change, since by the year 2050 natural low flow rates will be halved in the Garonne basin. Following a consultation phase, the study concludes by raising a societal issue: What flow rate do we want in our rivers during the summer, and what can we dofor this purpose? Three main scenarios were devised based on the choices resource managers could make: let nature take its course and accept much lower flow rates, conserve nature in its current state by offsetting the effects of climate change, or limit vulnerabilities by giving partial focus to low flows. The quantified data, at least in a relative sense, and conclusions, robust regardless of the scenario, help shed light on the debate and make a strong case for the decision to anticipate the issues and impacts global change could have on the basin.

Source: Adour-Garonne Water Agency

URBAN SAFETY AND SOBRIETY: MUNICIPAL PRUDENCE AND PROTECTION

by Sabine BARLES, professor at l'Université Paris 1 Panthéon Sorbonne

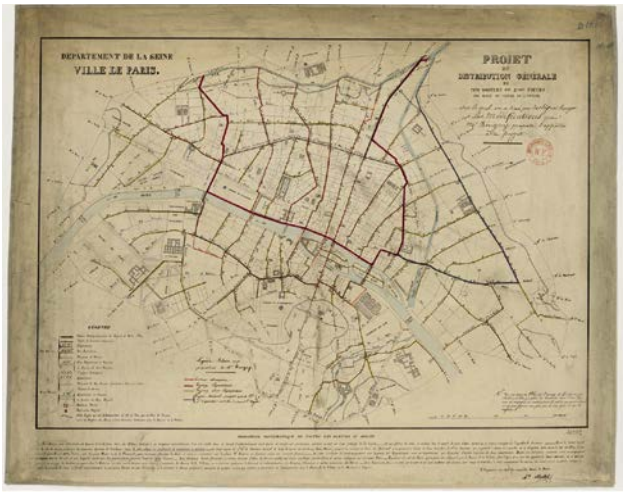
As towns are experts in health and protection, they have historically provided services to meet these two objectives. This has been the subject of many historians' work, from the medieval and modern periods to the contemporary period. In this article, Sabine Barles describes the challenges related to municipal services as they have evolved since the French Revolution and as a result of the industrial revolutions

Municipalities, created by the French Revolution, are explicitly responsible for their own safety, protection and health (authority is divided between the two prefectures - the Police and the Seine - in Paris), which is why they are in charge of managing their water, sanitation, and waste, even before they were more explicitly defined as local public services, notably by the 1902 law on the protection of public health. We can thus say that these services were born from a need for protection, and have long been dedicated to protecting citizens from health risks and natural disasters (because they contribute to flood control). The issue of prudence is not foreign to the history of public services, either. At first it was a constraint - managing shortages - before becoming, much later, a mission - saving resources.

The long 19th century: safety and scarcity, two convergent issues?

Distributing safe water, collecting and disposing of dirty and excess water, soil sealing (although this term was not used) contaminated urban land, a source of airborne contamination, renewing polluted air, removing sludge and refuse, separating or removing unhealthy or dangerous activities: these were the main components of public hygiene projects in the nineteenth century that aimed to ensure the public's health, in the context of an abnormally high urban death rate (more people die in the city than are born there, and people die in the city more often than in the countryside), a growing population, and an industrial boom. This intervention focused on public spaces, and attempts to pass legislation on substandard housing was met with fierce opposition from property owners.

As water began to be viewed as a universal cleaning agent, it became necessary to increase its availability. Municipalities and the State multiplied their efforts to bring water into cities in order to offset local shortages of clean water: rain water was quantitatively insufficient to meet new needs, well water was contaminated by cesspools and the organic materials that permeated into the ground, supplies of water from rivers were not always sufficient, and were also sometimes contaminated. In Paris, the Canal de l'Ourcq was built in the early nineteenth century, then, starting in the Second Empire, sources were diverted to the Seine basin, and the Seine and the Marne also became contributors. In Toulouse, water from the Garonne was filtered and distributed in the late 1820s. In Dijon, the source of the Rosoir was captured in the 1830s. In the late 1860s, the Verdon started to supply cities in the Aix-en-Provence basin via a channel. This conquest of water, to borrow the title of the book by Jean-Pierre Goubert, had not yet reached all of France.



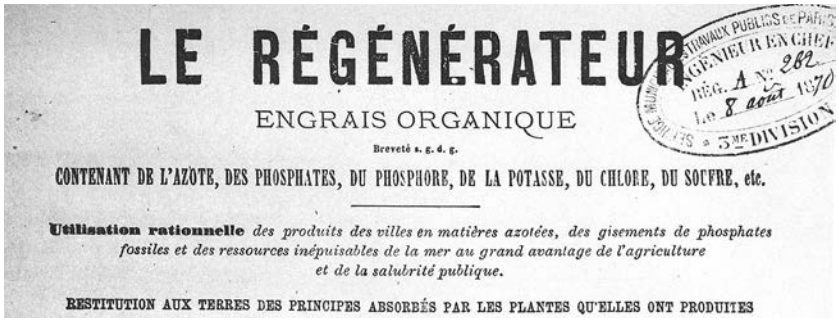
DEPARTMENT OF THE SEINE. CITY OF PARIS.
GENERAL DISTRIBUTION PROJECT FOR 7678 MODULES OR 4000 INCHES OF WATER FROM THE CANAL DE L'OURCQ, 19TH CENTURY

Source: Bibliothèque nationale de France [French national library], GED-1616

The management of urine and faeces, mud and refuse, is a logical and fitting part of this project on health security. It also brought up another challenge: that of food safety and the fear of shortages that gripped the nineteenth century. Population growth, combined with the scarcity of manure, generated a frantic search for anything that may have fertilising qualities, and urban and human fertiliser (prepared from the excreta of the city's inhabitants) were particularly sought after. At the time, people reasoned that the city needed to return, in the form of fertiliser, what it took the countryside in the form of food. Sludge and refuse, once sorted (after rag-pickers recovered rags, bone, metal, paper, etc., which were useful to industry), were used by the booming market of vegetable growers and even exported on horse-drawn carriages, then trains and ships to more distant agricultural areas. Urine and faeces were the subject of numerous patents for transforming the nightsoil extracted from cesspools (into which dry latrines drained so that water did not enter the living area) into sewage powder, urate, stercorat, animalised seagrass, ammonium sulphate, etc. When water entered houses and sewer connections became essential, an intense debate emerged about what to do with sewage: how could the fertilisers they contain be retained and used? The solution required developing sewage farms, with the goal of achieving a combination of urban sanitation and food safety - although the medical profession did not endorse this project unanimously. Montélimar, Reims, Perpignan, Paris, to name a few, did this with their sewage in the late nineteenth century.

The 20th century: safety compromised by abundance?

This model, which combines health safety and food safety in the quest for public health and the struggle against shortages, started to undergo a transformation during the interwar period. Cities continued their efforts to conquer water resources, but increasing consumption was not called into question. The prevailing model was that water must be abundant, like food. Even if voices rose up from the 1960s onwards to change this way of thinking. Major pipeline work was undertaken not only to supply cities, but also to improve agricultural irrigation (the Sivens dam is probably one of the last projects of this kind) and promote economic development. Since the interwar period, the city of Paris has constructed several dams and reservoirs in the Seine basin to support flow and maintain water levels during the river's low-flow periods in order to avoid summer shortages and ensure that the river remains navigable. The Société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CONTENANT DE L'AZOTE, DES PHOSPHATES, DU PHOSPHORE, DE LA POTASSE, DU CHLORE, DU SOUFRE, etc.

Utilisation rationnelle *des produits des villes en matières azotées, des gisements de phosphates fossiles et des ressources inépuisables de la mer au grand avantage de l'agriculture et de la salubrité publique.*

RESTITUTION AUX TERRES DES PRINCIPES ABSORBÉS PAR LES PLANTES QU'ELLES ONT PRODUITES

THE CONVERGENCE OF URBAN SANITATION AND FOOD SAFETY : ADVERTISEMENT FOR AN URBAN FERTILIZER, LE RÉGÉNÉRATEUR, 1870

Source : Archives de Paris

Bas-Languedoc-Roussillon was founded in 1955 to supply new coastal cities and local farmers with water from the Rhône. The Société du Canal de Provence was created in 1963 to provide the water supply for part of Provence. The new infrastructures that have been built (the St. Croix dam in the Verdon and the Canal de Provence, in particular) have made the old Verdon canal obsolete. This is one example of the many abandoned infrastructures scattered through the landscape: another form of waste resulting from the doctrine of abundance. There are many examples that demonstrate this conquest of water resources.

PANNECIÈRE-CHAUMARD LAKE RESERVOIR
Photo: Benchaum

Meanwhile, the discovery of fossil phosphates (in the second half of the nineteenth century), the development of the Haber-Bosch process, which converts atmospheric nitrogen into ammonia to make explosives and fertilizers (1909), and potash mining in Alsace (1910) lessened scarcity and gradually rendered human and urban fertilizers obsolete. Urban waste - what something must be called as soon as it no longer serves a purpose - was then thrown into landfills, thrown into the sea or rivers, and sometimes incinerated. The water now qualified as wastewater was dumped into rivers, lakes, and seas. In 1950 there were barely fifty wastewater treatment plants in France, and by 1960 there were only three hundred and fifty. The Common Agricultural Policy, created in 1957, set agriculture on the path to industrialisation and overabundance, and resulted in increased household consumption. Not only had urban detritus lost all value, but food waste and the development of products with short shelf lives led to an explosion in the quantity of wasste.

The abundance that came with this prosperity has a downside. Abandoning excreta degrades water resources, pollutes aquatic and terrestrial environments, and contaminates the air: both directly because they are discarded without being treated - or are inadequately treated - and indirectly because they are combined with the emergence of the serious problem of agricultural pollution. This contributes, alongside the quest for abundance, to the depletion of certain resources (e.g., fossil phosphates) and adds to climate change, which in turn has a direct effect on water availability, agricultural production, etc.

From prudence as a constraint to prudence as a goal?

All this ultimately puts urban metabolism in question—today it is linear, intense, and nearly entirely outsourced. The abundance, health, and safety that it seems to allow for and which have spurred the development of municipal service networks may just be illusions, considering the importance of resulting effects. Prudence is now seen as an alternative to this model, a way to a more circular metabolism, a step on the path to dematerialising (i.e., reducing material consumption), substituting fossil resources with renewable resources, and territorialisation. Such a project necessitates an overhaul of the way the municipal services network is organised, the professions responsible for them, and the institutions that manage them. Municipal engineering, in short.

PRUDENCE AND PROTECTION: TWO INSEPARABLE VALUES FOR THE PUBLIC SERVICE OF MUNICIPAL DRINKING WATER. THE EXAMPLE OF SEDIF

by Véronique Heim, Director of studies and outlook at the Syndicat des eaux d'Ile de France (SEDIF)

SEDIF is the largest public drinking water service in France thanks to the size of the population served, area covered, infrastructure, and the economic importance of the capital region. Since its creation, elected officials have wanted to offer residents an efficient and modern public water service. As such, this service is notable for its high level of safety, its optimisation efforts from an economic (because "water pays for water") and technical point of view thanks to expertise in industrial processes and the ability to limit their impact on the environment.

SEDIF is an organising authority and public contracting authority. Its territory covers more than 796.7 km^2 in a very mixed environment of highly urbanized cities, particularly in the departments of the inner suburbs, to primarily suburban cities and even semi-rural areas.

Managing a quality public water service in a densely populated urban area motivated SEDIF to integrate security features into every aspect of the design and management of its infrastructure. To provide its cities' urban consumers with an improved quality of life and foster harmonious development, prudence must be integrated with sustainable development and the pollution generated by its activities must be reduced. Promoting actions that favour water conservation, respect for the environment and biodiversity, waste recycling, and the concept of the circular economy, now being developed by the world of industry, are indispensable components to the construction of the Metropolis of Greater Paris, and will serve as a worldwide inspiration with regard to the controlled economic and urban development of suburban cities. But how do public water services contribute to prudence and protection for cities?

The stock of assets includes three production plants that draw surface water from rivers, four groundwater production plants, 45 pumping stations, 67 reservoirs, 39 rechlorination stations, and a 8,367 km network for transportation and distribution.

It provides water to 4.4 million people, which amounts to 236 million m^3 of water consumed annually and 750,000 m^3 of water distributed each day. The facilities require 195 Gwh to operate.

These 4.4 million people represent nearly 40% of the Ile de France region's population. Ninety-five per cent of their drinking water comes from three major rivers, the Seine, the Marne and the Oise. These sources are characterized by chronic diffuse urban, industrial and agricultural pollution, are threatened by accidental pollution, and are also affected by seasonal variations due to climatic conditions.

Source: SEDIF

AERIAL VIEW OF SEDIF'S MÉRY-SUR-OISE PLANT
Photo: SEDIF

The Safety Management Plan: a major tool

Drinking water is classified by the French government as vital to economic activity. Since the attacks of September 2001, the French Vigipirate plan has been in effect nationwide. The very recent and dramatic events that took place in January 2015 have shown once again that the terrorist threat remains.

As such, the revised Defence Code declared that network operators and their facilities are of vital importance. To ensure the network's safety, these regulatory provisions and the Vigipirate plan implemented a strong policy with protective measures both for the investments and management measures. The size of the service, the significance of the assets, the remoteness and isolation of certain sites, and secondary sites without personnel that operate autonomously prompted SEDIF to conduct vulnerability studies, investigating terrorism and malicious acts.

Thus the key issues to ensure safety are:

- to preserve the integrity of the entire production, transport, and distribution system, including all of the components in its superstructures, buried structures, hydraulic, electrical, and underground components, and information and telephone systems and networks,
- to protect all sites throughout the territory with measures proportionate to risk and the nature of the equipment,
- to detect all malicious acts, conduct necessary investigations, and take operational measures if a risk is confirmed in order to ensure control over the quality of the drinking water supply,
- to implement Vigipirate measures in accordance with its activation level.

To respond to these security issues, objectives were set in terms of investments and management measures.

The following were deemed to be the most important measures to investment in:

- defining the security management plan, with several phases to spread the investment burden (over €25M) made according to priorities from major factories to all secondary sites;
- classifying all facilities and operational units according to a scoring scale based on the role of the operational unit or facility, defining critical points, and establishing graduated provisions;
- deploying active protection devices combining the most innovative technologies in terms of remote surveillance, biometrics, hyper vision systems, etc., and also passive security protection systems: installing 2.5-m high fences and defensive hedges, securing all openings, covers, doors, hatches, etc., and access control sensors throughout the network;
- protecting the most sensitive areas;
- defining integrated design rules for works operations;
- establishing public procurement tools to meet obligations.

As for some of the management measures:

- implementing surveillance and access control measures,
- controlling the dissemination of information regardless of medium, digital or paper,
- controlling the integrity of the information system (ISO 27001)
- raising awareness and training of company personnel and all stakeholders: companies, suppliers,
- constant monitoring, establishing warning procedures, intervention procedures, and crisis procedures,

- cooperating closely with government services: prefectures, local and national police, etc.

But safety is not just physical protection and monitoring production and distribution sites, it is also the result of many other actions.

Safety of the service

Being able to provide a quality public water service that can supply enough water 24/7 is a crucial component of protected city. The following are the means by which SEDIF meets these objectives.

Addressing the issue of health

As the production and distribution of drinking water to consumers' taps is effectively a food service, doing so must comply with the Code of Public Health, articles 1321-1 et seq. Health security is the responsibility of the PRPDE (person responsible for the production and distribution of water)[1]. This person controls the entire production/distribution chain using a variety of tools that help guarantee quality standards. The main ones are:

- An HACCP (Hazard Analysis Critical Control Point) approach, developed by the pharmaceutical and food industries, which led to ISO 22000 certification and helped identify the points in the production and distribution system that could pose risks to water quality. When critical points are identified, surveillance and risk management procedures are put in place.
- Two levels of control: **sanitary control**, official inspection carried out under the authority of the Ile de France Regional Health Agency (ARS), entrusted to approved laboratories that perform nearly 100,000 analyses per year. This is complemented by the **health monitoring programme** developed to manage facilities and ensure that distributed water complies with regulations, which is achieved through: 200,000 resource analyses carried out at taps, sometimes continuously. Beyond the 54 regulatory parameters, this includes monitoring of 11 additional parameters.
- Warning stations upstream of the intakes in the three main plants, which make it possible to adjust the treatments. An information network (firefighters and municipal services, industrial networks, water producers, fishing associations, etc.) run by agents of the 'Mission Anti-Pollution' covers each of the waterways and quickly sends out warnings from plant control stations in case the water quality upstream from plants falls below acceptable limits.
- Measures to protect the resource (Phyt'Eaux Cités with regard to urban pollution by pesticides, PRERI to limit risks related to industrial sites).
- Treatments in the most effective and innovative drinking water treatment plants, including the membrane treatment plant in Méry-sur-Oise, or, to disinfect with traditional processes, a device with targeted barriers for different types of microorganisms that combines sand filtration, ozone, UV reactors, and chlorination.
- Close contractual monitoring: Of the 136 operating activity monitoring indicators, 52 involve water quality. The objective is to achieve 100% sanitary compliance, and any anomaly is subject to a contractual penalty.
- Monitoring the water quality in the network. Rechlorination stations are spread throughout the network. Also, since 2011 SEDIF has committed itself to total traceability for the water distribution process by installing a network of 200 Qualio probes in its distribution network, currently being deployed in order to perform continuous measurements of pressure, temperature, chlorine and conductivity, which are used for quality modelling.
- To anticipate regulatory changes and adapt the performance of its treatment processes to the highest standards, SEDIF is also developing a substantial testing and research programme, with a highly pragmatic aspect devoted to constantly improving its facilities and more prospective aspect that involves the best expertise and insight from France and abroad. Analytical monitoring of emerging micropollutants (medicines, phthalates, alkylphenols, perfluorinated compounds, oxidation by-products, bisphenol A, etc.) is performed, and the ability of the treatment processes used to reduce them is evaluated. The test centres are already evaluating the performance of different types of membranes, nanofiltration, and OIBP in the elimination of emerging pollutants.

[1] Person in charge of the production and distribution of drinking water

Addressing shortcomings by improving security

The economic importance of the area served and its population density make any service interruption problematic. SEDIF serves many areas of activity and businesses: half of the Paris business district La Défense for example, including its shopping centre, and the Rungis International Market. Leaks in the transportation pipelines under the road infrastructure can quickly create serious repercussions on the surface. Firefighting needs are often used to calculate the volume required for the network's design. This is why the SEDIF has a robust and secured infrastructure. The replacement value of its assets is valued at €10 million, 8 for the network and €2 million for its industrial assets. It invests €120 to 150 million annually, much of which is dedicated to renewal.

The plants are interconnected with each other via large diameter pipes running in both directions, which can thus help each other in case a plant were to be stopped or have its capacity reduced because of an operational event or renovation work. SEDIF production plants are designed to be able to produce double the current average consumption. The difference between peak consumption and maximum production capacity is the safety margin, in case a resource or a plant is unavailable. A safety margin of 30% compared to peak consumption, which was only 20% 20 years ago, grew due to the decrease in volume consumed.

The reserves' average autonomy of 10 hours and intercommunication with neighbouring distributors strengthen this security.

It is a highly meshed transportation and distribution network that ensures continuity and limits water stoppage periods, with the objective of optimising response times. Electrical security is ensured with dual power feeds to the major plants and power generators at secondary sites.

Addressing vulnerability

Plants were established in the late nineteenth century on the banks of rivers in areas susceptible to flooding. The other components of the network, the water towers, were often built on hills and supplied by intermediate pumping stations to provide water to the high points of the territory. Due to urbanization, all these components are now in the heart of cities.

This system is faced with multiple risks: internal risks - technological, breakdowns, operating incidents - and external - climatic incidents, storms, floods - but also intentional - malicious acts and pollution. These risks have shaped the facilities' design and management: environmental regulations for ICPE installations, hazard assessments (aiming to identify industrial risks associated with chemicals in particular), environmental studies, and public health vulnerability studies. These are conducted to evaluate sensitivity levels, taking into account criteria for protecting the site, equipment, monitoring, responsiveness and severity compared to the loss of a facility.

Annual FMEA (Failure Mode and Effects Analysis) type studies are also carried out by the operator to decide which equipment should receive scheduled maintenance.

Finally, this system also includes continuity and contingency management plans: plans for floods and heat waves, safety management plans, and a last resort plan to anticipate and plan crisis response measures, all of which increase safety.

The cost of securing the service amounts to € 0.25 per m^3 of water. Some programs require heavy specific investments: almost € 10 million over nearly 8 years was needed to protect the main plants from flooding, and nearly € 25 million to ensure the security of all of its facilities' active and passive protection systems, a major project which involved over 80 separate sites. These precautions were necessary in order to comply with the Vigipirate regulations.

The issue of the resilience of facilities and equipment when threatened by flooding is also taken into consideration, to determine the fastest way to return to the service to its normal level of operation and efficiency.

REMOVABLE ANTI-FLOOD BARRIERS AT THE CHOISY-LE-ROI SEDIF PLANT

Photo: SEDIF

The security of information systems: IT systems are now at the heart of our cities, professions, exchanges, information and communication. Cyberattacks have become threats with dire consequences, as they can bring whole networks to a halt. To address this risk, the SEDIF delegation brought their information systems' security level up to ISO 27001 certification standards.

All of these actions taken to ensure safer services are also accompanied by a desire to reduce impact on cities' urban environments. The water service needs to be exemplary. It must contribute to improving citizens' quality of life and address the need for greater protected.

A prudent service

Global warming, the measurable phenomenon announced in the IPCC reports and the focus of the COP 21, to be held in Paris in December, has become a global issue that will require a worldwide effort to resolve. Among the first public services to become ISO 14001 certified in 2002, SEDIF committed itself to a proactive policy of preserving the environment, as shown by its environmental management plan, and confirmed by a sustainable development charter that incorporates societal and economic aspects. To deal with the increasing scarcity of water resources, energy, the degradation of environmental quality (air, water, soil), and in the interest of finding ways to save, the main tenets that guide the improvement of public water services are:

- **Preserving water resources** by taking actions to reduce pollution at its source:
- **Finding ways to save water**, through a multitude of combined actions, both for the service and for the consumer, which include:

  > For the water service:

Phyt'Eaux Cités, a multi-partner effort launched in 2006 carried out across a vast territory including 133 communes in the Orge and Yvette watershed (direct tributaries of the Seine), upstream from drinking water production plants, aims to limit the use of phytosanitary products in urban areas and promotes 'Zéro phyto'. A new effort to reduce agricultural, urban and industrial pollution has just been launched for Champigny's limestone water table.

Source: SEDIF

  - By optimising the performance of the drinking water network and limiting losses, by quickly identifying leaks (acoustic sensors, monitoring of night flows), controlling pressure, compartmentalising, the network's instrumentation, good knowledge of the network's assets and the optimization of its renewal;
  - By looking for ways to save water in factories and the network.

> For water consumers:

- By gradually commissioning AMR (automatic meter reading), which will be fully operational in late 2015 throughout the SEDIF network and will allow constant control of its consumption and immediately identify loss due to leakage;
- By communicating with users to increase their awareness of simple ways to reduce their consumption; with consumption simulators to help them control their water bill.

- **Energy efficiency and use of renewable energies:** producing clean water and getting it to the consumer's tap requires energy—over 195,000 Mwh in 2013. Aware of the need to reduce its consumption, SEDIF set ambitious objectives for its delegation to reduce energy consumption: first lowering consumption by 1% in 2015, then 3% in 2018, and finally 6% in 2020. A variety of means were sought to reduce consumption, including:
  > finding more energy-efficient pumping equipment to replace older models,
  > introducing a tool called GTCE (French acronym meaning 'technical management of energy consumption'), for monitoring electricity consumption at all sites,
  > installing a heat pump with heat exchangers to recover the calories given off during membrane treatments (the concentrate) and heat the membrane regeneration tanks. This project was made a priority by ADEME,
  > researching renewable energy: a pilot study with photovoltaic panels is underway at the Choisy-le-Roi plant,
  > using vehicles that run on clean energy, at a rate of 4.5% in 2014, 15% in 2017, and 25% in 2021...
- Reducing greenhouse gases by balancing the carbon footprint with offset mechanisms such as reforestation to make services carbon-neutral. The objectives set out in the contract involve reducing greenhouse gases by 5% in 2015, 10% in 2018 and 33% in 2020,
- Taking the circular economy into account in all sectors of activity, with regard to operations, equipment maintenance, and investment works:
  > production techniques that favour recycling materials,
  > construction waste recycling,
  > life cycle analyses for the supplies and materials used in all aspects of projects,
- This list continues, including approaches such as reducing the use of chemical reagents and introducing green chemistry.

To measure the results of these actions, which are part of the delegation contract, a set of performance indicators were established, with penalties if objectives were not met.

Furthermore, all new investment projects are accompanied by an operating costs assessment calculated based on the life of the equipment, to make the most pertinent choices and integrate global economic calculations.

To assess SEDIF's impact on water resources, the service's **water footprint** was calculated as part of a thesis, the results of which have yet to be more carefully explored. It was based on a method developed by VERI, a research and development unit at the Veolia Group. This method assesses the impact of the activity on the quality of the river and its availability for other uses based on the volumes taken from and discharged into different rivers.

Leads for the future

SEDIF is taking action today to make the cities of tomorrow even safer and more prudent.

Faced with the presence of emerging micropollutants detected with increasingly powerful analytical methods and risks to consumer health, it carries out testing on high performance treatment processes which, beyond reducing chemical pollutants, will also reduce organic matter and lime, resulting in softened water and with very little or no chlorine.

New information and communication technologies have enabled us to imagine a city where all the data compiled on public services (water, energy, communications, and waste as well as transportation and public areas) will be constantly centralised so that citizens receive the best service possible. There are already many smartphone applications that provide real-time access to this information. More possibilities for these new technologies are devised every day.

Since 2011 SEDIF and its delegation has worked to set up ServO, a single control centre for the entire public water service that allows users to manage the resource

network on a day-to-day basis. It allows for real-time coordination of production, distribution, water quality control, customer relations, risk management and reporting.

This system is composed of high-tech computing applications that share common databases. It is coupled with specialised tools of the trade such as mapping, hydraulic simulation models, energy consumption monitoring, and even intelligent sensor systems deployed on the network like Qualio sensors for continuously measuring quality parameters and Res'Echo sensors for pre-recording leak detection logs.

This system provides continuous 24/7 surveillance and optimises operators' responsiveness to exceptional or unscheduled events and their ability to manage crises.

It is scheduled to gradually roll out until 2017. It should be enhanced by several expert systems that are based on "Big Data" data archiving, and will provide improved service performance.

This tool fits perfectly with the concept of the **Smart City**, metropolis of the future, which relies on new digital technologies to create a closely monitored city where information from all the service networks can be interfaced and coordinated. Platforms developed around complex digital simulation tools will serve as helpful decision support tools, helping to assess the different potential impacts of projects. New projects will combine energy cost optimisation, reduction of pollutant emissions into the air and water, heat recovery, and wastewater and storm water recycling, all to the benefit of a sustainable, environmentally-conscious city.

These new tools make it possible to put **consumers at the heart of the service**. Deploying AMR devices should multiply individual counts over time and thus bring service subscribers closer. The new communication tools will allow consumers to stay better informed and express their expectations for quality and consumption monitoring. Consumers are becoming key players in safe and sustainable cities.

MUNICIPAL SANITATION
MUST IMPROVE PRUDENCE AND PROTECTION

by Jean-Marc PICARD, Health & Environment Director at SIAAP, Syndicat Interdépartemental d'Assainissement de l'Agglomération Parisienne (Paris urban area interdepartmental wastewater treatment authority)

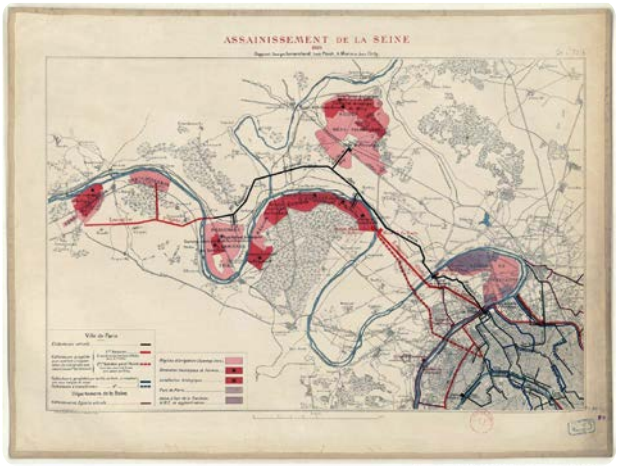
Each day, SIAAP cleans the wastewater of nearly 9 million Parisians, as well as storm water and industrial wastewater, providing the Seine and the Marne with water that is conducive to the development of the natural environment. For the last two decades, SIAAP has been transforming its industrial tools, all located in urban areas, to achieve high performance in wastewater treatment. Due to land scarcity and the encroachment of urbanised areas,

treatment facilities must be compact and follow stringent safety precautions. The use of intensive water treatment technologies is transforming the economy of the sanitation sector, which is now guided by the issues of prudence and protection, as explained by Jean-Marc Picard, Health and Environment Director at SIAAP.

THE THREE ISSUES THAT HAVE SHAPED THE SANITATION SYSTEM IN THE PARIS URBAN AREA

The first issue: public hygiene

Public hygiene is the fundamental and historical challenge of urban sanitation. The primary response to this challenge was made over a century and a half ago, with the construction of underground sewer networks that helped isolate the population from the health risk posed by sewage. The scheme implemented in the last century has long guided the capital's water management and sanitation strategy:



SANITATION OF THE SEINE, GEORGES LEMARCHAND REPORT, LOUIS PEUCH, A. MARIN ET JEAN COLLY. 1926.

Source: Bibliothèque nationale de France [French national library], Maps department, GE C-5313

intake water upstream of the city for its drinking water supply, and discharge wastewater downstream of the city.

The environmental reconquest of large rivers

The growth of the Paris region quickly revealed this plan's limits. The growing need for drinking water has resulted, with the help of technology, in more than half of the water supply now coming from surface water collected from the heart of the city. Similarly, starting in the late nineteenth century, the environmental problems caused by the direct discharge of wastewater led to the establishment of purification techniques. With the population growth of the post-war period, the issue of pollution in waterways became increasingly important, to the point where the aim of sanitation went from resolving a public health problem to, in the 1970s, an environmental reconquest of the Seine and the Marne.

A requirement specific to Paris: decentralisation

In addition to the environmental objective of protecting waterways, SIAAP aims to "decentralise" its wastewater treatment units. Until the mid-80s, its water treatment capabilities relied solely on the Achères station in Yvelines. After several expansions of its capacity, the size of this station was deemed excessive. Since then its capacity has been reduced, and the slack has been picked up by new processing units spread around the city.

Thus, the last few decades have been spent optimising wastewater treatment performance, dividing the work amongst several sites all located in urban areas.

These issues have guided SIAAP's actions for two decades. SIAAP underwent a complete transform of its industrial tools, much of which is already complete.

The construction of the biological treatment column at the Seine Aval plant is currently the largest sanitation project ever undertaken in France. It will conclude the transition to a high-performance wastewater treatment, while the Seine's upstream plants at Valenton, Seine Centre, Seine Grésillons and now Seine Morée complement this project.

REDESIGN OF THE BIOLOGICAL TREATMENT COLUMN AT THE SEINE AVAL PLANT:
CONSTRUCTION OF BIOFILTRATION UNITS

Photo: SIAAP

A TRANSFORMATION IN TWO DECADES: COMPACT PLANTS IN URBAN AREAS

Plants in urban areas

SIAAP's wastewater treatment plants are now all in urban areas. They work day and night, require a reliable supply of energy and chemical reagents, and must achieve high levels of performance, all while preserving the living environment of local residents.

The main constraint is the scarcity of urban space. Sanitation contributes to the city's development, but at the same time, it must be space-efficient, and take up as little room as possible.

This pressure is particularly strong for new construction projects. To be accepted, projects must be more compact so that they occupy a smaller surface area. Some designs even allow for the space just above them to be occupied.

A very recent example is the Seine Morée plant, with a capacity of 300,000 Equivalent-Residents on a plot smaller than 2 ha. This new plant, created in the urban area of Blanc Mesnil, is particularly compact. Its design necessitated the use of intensive purification techniques, adapted to the constraints of compactness and performance.

These plants are usually buried to comply with urban planning requirements regarding building heights. As such, the overhaul of the Seine Aval plant requires major excavation to create new units without exceeding 20 meters above ground level.

SEINE MORÉE: A COMPACT URBAN PLANT
Photo: SIAAP

The use of intensive processes

Indeed, SIAAP's purification tools have undergone a transformation over the past two decades, from units occupying a large amount of space and employing traditional extensive techniques with biological tanks and other units spread out over the ground, to compact plants that make use of intensive purification techniques, such as biofilters and membranes, and reduce the footprint.

This technological evolution is spurred by demands for performance and compactness. These techniques allow for successful architectural integration. Compactness also leads to better control over nuisances. It also facilitates odour capture and treatment. Noise emissions are reduced by the presence of buildings. The difference is dramatic: after reconstruction took place at the Marne Aval plant in Noisy-le-Grand (93), complaints related to nuisances nearly disappeared in the area around the new compact units.

PRUDENCE AND PROTECTION REQUIREMENTS TO ENHANCED

Compactness comes at a cost

These intensive water purification techniques come at a cost. They consume more power and require the use of chemical reagents, which is why solutions are being sought to deal with the issues of prudence and protection.

Water purification consumes energy and reagents. These are sources of greenhouse gas emissions that SIAAP must control, just as any environmentally responsible organisation should. They are also expenses that must be considered.

Currently, the average amount of energy needed annually to depollute wastewater is about 1000 Gwh. In other words, the domestic electrical consumption of about 300,000 people, of which 550 Gwh/year are purchased, resulting in an expenditure of €30 million.

To purify water is to spend energy

Controlling operating costs also encourages finding good ways to deal with energy issues. Water treatment consumes various types of energy: electricity, natural gas and/or biogas, fuel, and heat. If we were to add up all the energy consumed during the treatment of wastewater and sludge, it would amount to about 1.2 KWh/m^3, however this figure can vary depending on the pollutant concentration at the inlet and the method used.

SIAAP is working to optimise the energy efficiency of its purifying processes, in particular applying the optimum ventilation rate depending on the weight of pollutants that must be eliminated. It is also working to optimise the efficiency of its electric motors, both in new operations as well as when renewing equipment. Improving buildings' ventilation management and

deodorising are the main levers for reducing power consumption. Other ideas should be investigated, such as temporarily reducing consumption at times when electricity is most expensive.

Water purification reagents: an indirect energy expenditure

Another aspect of controlling environmental impact is finding ways to save on reagents, as their production consumes energy resources. Producing approximately 16,000 t of carbon dioxide equivalent annually, reagents are the top contributors to the carbon footprint. The budgetary impact of reagent consumption is €25 M/year.

ENERGY RECOVERY IS BECOMING ESSENTIAL

Energy wealth is based primarily on sludge treatment

Sludge is produced when water is decontaminated. Processing this sludge also consumes a significant amount of energy, mainly in thermal form. But this sludge contains a wealth of energy comparatively, because it is rich in fermentable organic matter and therefore supports biomethane production. Thanks to this biogas, SIAAP is able to cover 50% of its total energy needs.

Agricultural use is currently the outlet for 60% of the sludge produced by SIAAP, 10% of sludge is used to generate energy in cement plants, and the rest is incinerated in SIAAP's facilities.

However, sludge can be used for energy recovery in an agricultural setting, the two are not exclusive. Whatever method is chosen, anaerobic digestion of sludge should be favoured because it both reduces the volume of sludge and produces biogas, which covers the energy requirements of the thermal sludge treatment. In its biggest plant, Seine Aval, SIAAP has reached 60% energy independence. Part of the biogas is also used to generate electricity through cogeneration. This self-production covers about 15% of the plant's electrical needs.

BIOGAS PRODUCTION : DIGESTERS CLUSTERS AND GASOMETERS OF THE SEINE AVAL WASTEWATER TREATMENT PLANT
Photo: Siaap

Injecting biomethane from wastewater treatment plants into the network offers new perspectives

Tomorrow's energy challenges will be linked to changes in the regulations on sludge, which is an important source of both thermal energy and biogas. New opportunities are arising that make it possible to the inject biomethane obtained from biogas generated by wastewater treatment plants into public networks. This development was expected, especially for the Seine Amont plant in Valenton, which produces a surplus of biogas. This reinjected biogas is then sold for the benefit of SIAAP, thus indirectly benefiting users and their water bills.

In fact, biogas reinjection is not just an economic issue, it also has ecological and security advantages. Ecological because biomethane is a substitute for natural gas and does not contribute to greenhouse gas emissions from fossil fuels. Security because by building on the natural gas network, which itself has significant storage capacity, energy management gains flexibility. By injecting biogas into the network, it would even be possible for SIAAP to get rid of buffer storage at its sites. These stockpiles currently warrant Seveso classification for the two main plants. Converting biogas into biomethane could make it possible to eliminate the risks associated with these stockpiles.

THE PROFESSION'S COMMITMENT TO ENSURING A HIGH LEVEL OF SECURITY

Security is a key issue in urban areas

Security issues are of utmost importance to both our employees and our residents. It is an unavoidable subject; compact plants operating in urban areas cannot suffer security flaws.

SIAAP operates most of its facilities directly, and employee safety is a priority at all times. This means providing the organizational techniques, means, and safety training to safeguard the physical integrity of all employees in the workplace. This also requires a reflection on the culture of safety. We must start with the reality of security, from workers to engineers, from employees to administrators, then accept the findings and look for ways to improve. Much has been done, and much remains to be done to be on a par with the best industry benchmarks.

Room for improvement in industrial safety

High-risk industries (e.g., chemical, oil) show that there is room for improvement to achieve higher levels of safety control. But this level of control requires improvements from all stakeholders: decision-makers, designers, manufacturers, operators, management, technical support, consulting firms, etc. SIAAP is firmly committed to improving the industrial safety of its facilities, with regard to both design and operation. This increase in competence must go hand in hand with all of these actors to gain shared control over these security issues.

In terms of industrial safety, efforts must focus primarily on design, from the earliest phase of projects. Implementing standards and security concepts shared by a whole industry results in secure facilities when they are operated in a disciplined manner. It is in this spirit that SIAAP has worked to draft a guide for designing biogas plants, working with professionals from a variety of backgrounds. This guide will serve as a reference for future projects.

ASTEE and professional associations have a role to play so that professionals in the water sector develop common industrial security tools for our fields. SIAAP supports the ASTEE initiative to establish an industrial security group within the sanitation commission to promote exchanges between operators and designers.

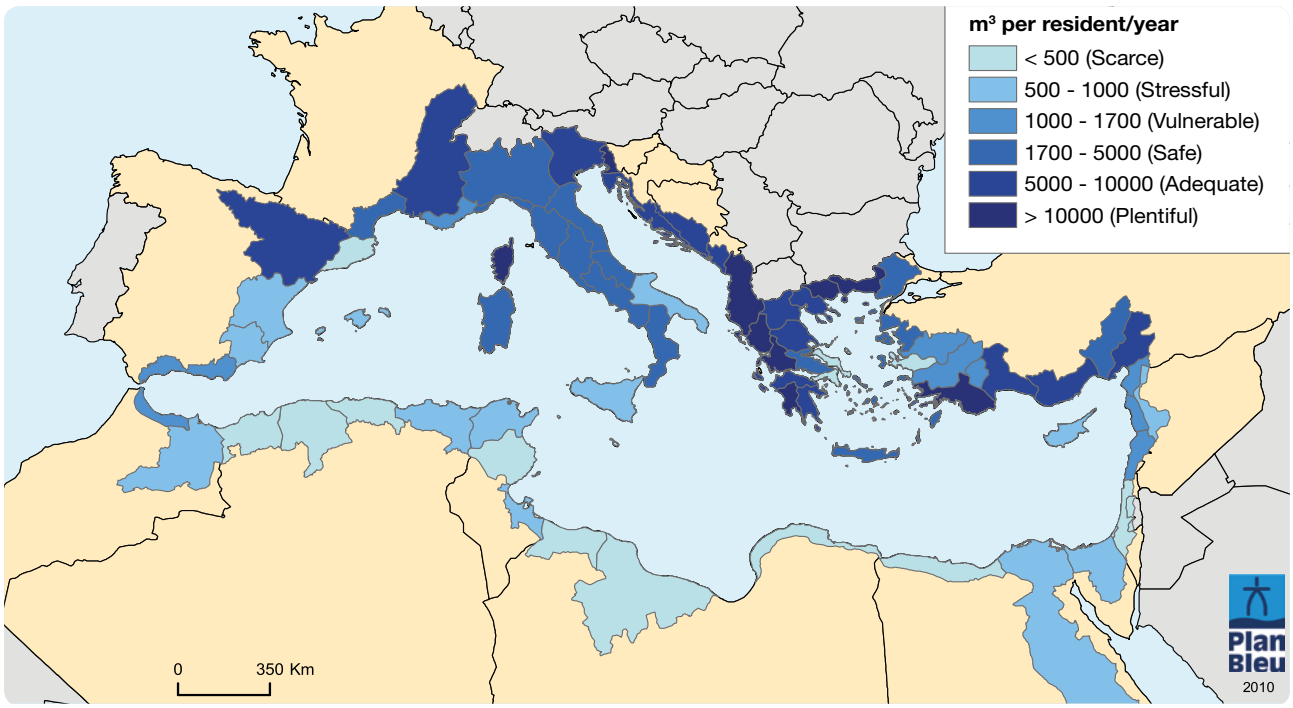
WASTEWATER RECYCLING (REUSE), A PRUDENT ALTERNATIVE FOR AREAS SUBJECT TO WATER STRESS

by Sarah Hercule-Bobroff (Veolia Eau), Christine Gandouin (SUEZ Environnement - Consulting department), ASTEE Sanitation Commission, and Boris David (Veolia Eau), ASTEE Water Resources and Aquatic Environments Commission

By turning wastewater into an alternative resource for the community and its partners, RTW (Reuse of Treated Wastewater) is now a recognised solution for sustainable management of water resources and a key element of integrated water resource management. RTW increases the overall amount of water available and in some cases it can be a safe alternative to drinking water and conventional resources for purposes that do not require drinking-water quality.

Growing needs and insufficient amounts of water have prompted research into new supply sources. Freshwater resources are generally abundant on a global scale, but supplies are unevenly distributed in space and time and can occasionally end up being insufficient to meet local needs.

The world's growing population, urbanization, pollution of surface and ground water, and the intensification of agriculture and climate change are all putting pressure on the world's access to water and increasing the need to protect resources. According to the OECD Environmental Outlook to 2050 reference scenario, 3.9 billion people, or over 40% of the world's population, will most likely live in river basins that experience high water stress.



RENEWABLE NATURAL WATER RESOURCES IN THE MAJOR MEDITERRANEAN RIVER BASINS IN THE PERIOD BETWEEN 2015-2010
Source: Plan Bleu 2011

While France is certainly fortunate to have a dense river network, it still faces local and/or occasional moments of water scarcity: insular areas, reduced precipitation in the Mediterranean region, heat waves, etc. When the water supply is highly dependent on weather conditions and multiple users are competing for limited fresh water resources, the occasional risk of shortages increases, which can make it difficult to make trade-offs between the various uses of water.

Prudence on a local scale is a major issue, vital for handling these specific situations. This issue should encourage water managers to discuss and agree on what quality level is suitable for each use and to look for alternative supply sources:

- collection, storage and reuse of rainwater,
- desalination of sea water,
- groundwater recharge,
- recycling grey water,
- reuse of treated wastewater, etc.

Reuse of Treated Wastewater (RTW)

By turning wastewater into a resource, RTW is now a key component of integrated water resource management. In some cases it can serve as a safe alternative to using drinking water and conventional resources for purposes that do not require drinking water quality. Plus, treated wastewater is a permanently available resource. Its volume increases as the population grows, and can be used even in the event of drought to avoid water shortages. RTW can be a solution to reduce or contain the stress put on freshwater resources and to help minimise conflicts of use.

It is also an environmentally-friendly solution to better reconcile the water needs of agriculture, industry, the community's development, and seasonal tourism. Setting up an RTW solution inevitably leads to better control of sanitation. RTW thus helps reduce amount of pollutants discharged into the environment. Having more control over mankind's influence on the water cycle helps to better protect resources.

Lastly, RTW provides communities and their partners with a way to save money, since recycled water is generally less expensive than imported water or desalinated water (GWI, 2015). The needs of communities, industries, and farmers would be met at a lower cost, especially if we analyse the water cycle as a whole.

Reuse of treated wastewater worldwide, and in France

Among the most well-known examples of this technique worldwide are: Israel, Singapore, Windhoek, and Los Angeles.

In Europe, the countries in the Mediterranean basin such as Spain and Italy are the most involved in RTW whereas only a few initiatives are worth mentioning in France, resulting in just 19,200m³/d , mostly reused in agriculture.

The example of the West Basin in Los Angeles (United Water)

This collection of facilities not only constitutes the largest water recycling activity of its kind in the US, it is also the only centre in the world capable of producing five different grades of recycled water "tailored" to industrial use.

Every day: 150,000 m³ for industrial use, reducing the need to draw water by half in one of the most drought-prone regions.

Security: how can it be reinforced?

The "Water Blueprint" published by the European Commission in 2012 highlighted the need to reuse treated wastewater in response to water stress. In 2013, the reuse of wastewater was even listed as a measure in the "roadmap" after the environmental conference. But despite the need and potential for development in Europe, this practice is not widespread among certain Member States. After an assessment of the situation in Europe and the main obstacles that face it, in 2014 the European Commission launched a consultation on the legislative instruments needed to promote this practice. Initial feedback indicated that the two measures that stakeholders considered to be most effective are legally binding regulations on minimum standards, and the potential for RTW in the basins suffering from water shortages.

To a lesser extent, promoting ISO standards 16075 (1 to 4) on RTW can help foster the growth of this practice. These guidelines govern the design, implementation, operation and performance of an RTW project to irrigate agricultural crops, green spaces and private gardens. They include practical recommendations for managing health, operational and environmental risks, from the treatment steps to point of use. France participated in drafting these measures via the AFNOR mirror committee. These standards are being finalised and will be available in 2015.

A local initiative in France to benefit agriculture

The Irrialt'eau pilot project illustrates the importance of this alternative resource in dealing with the chronic water stress affecting the yield and quality of vines in Languedoc-Roussillon.

Projet Irrialt'eau

This collaborative project, which involves the community, the operator, the agricultural cooperative and INRA, has been studying the impact of treated wastewater on two parcels of vines since 2013. Encouraging results for the soil, the groundwater table, and the finished product have demonstrated the benefit of eventually extending this practice to an entire vineyard (150 ha). These lessons learned from rational, sustainable viticulture will help spread this practice to other areas of the Mediterranean coast as well as to other cultures.

Reusing wastewater is a way to avoid the discharge of water loaded with nutrients into the natural environment (source of eutrophication), whereas by using them in agriculture or viticulture, they can benefit plants and partially replace industrial fertilizers (with the added benefit of lessening stress on phosphate resources). RTW in agriculture is a good example of the circular economy of nutrients.

AERIAL VIEW OF A PARCEL OF VINES IRRIGATED WITH WATER FROM THE NETWORK (in violet), RAW WATER (in red), B-QUALITY TREATED WASTEWATER (in green) AND C-QUALITY TREATED WASTEWATER (in yellow)

References:

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MUNICIPAL WASTE MANAGEMENT, SUSTAINING PROTECTION, INCREASING PRUDENCE

by Dominique PIN, Environmental Consultant, Honorary President of the European Federation of Waste Management and Environmental Services (FEAD)

Under French law, local authorities are responsible for disposing of the household waste produced by their inhabitants[2]: they must provide waste collection, transportation, treatment, and recovery. In a world that is more and more "urbanized" (85% of the French population lives in "urban communities"[3]), where lifestyles and consumption patterns demand more and more natural resources, waste management as a public service is constantly facing new challenges in meeting the needs of the "sustainable city", a city that is both prudent and protected.

An even more difficult challenge is that the amount of household and similar waste[4] continues to increase. We should not naively reassure ourselves by arguing that the quantities picked up by door-to-door collection services fell slightly since 2005, as this decrease is largely offset by the increasingly significant amounts that are collected by sorting/recycling centres, which must be taken into account.

The issues of protection

A protected city is a place where we can live peacefully, confident that we are safe from danger, a community that operates effectively. Further, it is also a place where hygiene conditions do not pose health risks.

The urban health measures that aim to prevent the miasma of waste and proliferation of harmful pests date back centuries. We have the famous prefect Eugene Poubelle to thank for imposing, in 1883, the use of a container with a lid for household waste to be set out for municipal collection. The utensil and its use has evolved since its creation: it no longer holds the contents of chamber pots, and has taken the form of a standardised plastic container that is now called a "bac roulant" ("wheeled bins"); many municipalities

NEW RUBBISH BINS, 1913

Source: Bibliothèque nationale de France [French national library], Prints and Photography department, EST EI-13 (282)

even carry out a regular washing and disinfection service for these bins.

Equipment that was installed in collective dwellings at the end of the last century that aimed to enhance living comfort but which carried health risks, such as refuse chutes, has been removed.

For about the last hundred years, refuse collection has been performed by means of "garbage trucks" that are completely closed off, which helps avoid releasing waste and dust into the atmosphere. These vehicles

[2] Code of local authorities, L 2224-13

[3] INSEE survey, 1999. An urban commune is a municipality that is part of an urban unit, a concept that is based on the continuity of the framework.

[4] Non-hazardous waste from households or from industrial sources, artisans, merchants, schools, public services, hospitals, or tertiary services when they are collected in the same conditions.

are equipped with engines that satisfy increasingly stringent anti-pollution standards, and more and more often they employ hybrid and electric propulsion technologies, non-polluting and silent.

If the nuisances related to waste collection in urban areas seem well under control today, what will the next stage of waste management involve? Shouldn't cities fear the "boomerang" effect of pollution caused by inappropriate or ineffective treatment of this waste?

Since the 70s, waste treatment and recovery facilities gradually became subject to strict regulations, essentially from the EU level, which prescribe the measures to be taken to ensure a high level of environmental protection and set the pollutant discharge limits that different processes are allowed to emit into the environment, air, water or soil. These values are determined so as not to cause public health problems.

Take thermal waste recovery for example, which generates energy by unlocking the waste's calorific potential. Fifty years ago, the smoke produced by burning waste was not subject to any regulatory constraints, not even for abundance of dust they spewed into the atmosphere, nor for the acid gases that fell in the form of "acid rain", which is terrible for vegetation. Today, regulations have set out strict measures to deal with the smoke from incineration plants: combustion gases from burning waste must be heated to 850°C for at least two seconds to destroy organic pollutants and must also undergo filtration and treatment. Limit values for emissions into the atmosphere have been set for the principal residual pollutants of this treatment: dust, hydrogen chloride, sulphur and nitrogen oxides, and metals (lead, mercury, thallium, cadmium, etc.). A threshold limit value has also been set for carbon monoxide to ensure combustion quality compliance. To confirm the consistency and effectiveness of smoke pollution control systems, emissions are measured and/or recorded continuously or semi-continuously.

After populations living near incinerators expressed concern about the dioxins they emit, since 2002 they have been subject to particularly strict standards and must not release more than 0.1 nanograms of dioxin per standard cubic metre of smoke. As such, the total amount of dioxins emitted by all the waste incinerators operating in France has fallen from 1,100 grams per year in 1995 to less than 10 grams per year today. Should we be alarmed that no health authority has called fireworks into question, even though they release several grams of dioxins at every festivity?

THE SPITTELAU HEAT RECOVERY PLANT (VIENNA)
DESIGNED BY HUNDERTWASSER
Photo: Emiliano

The requirements of prudence

Waste management in our cities undoubtedly offers protection today!

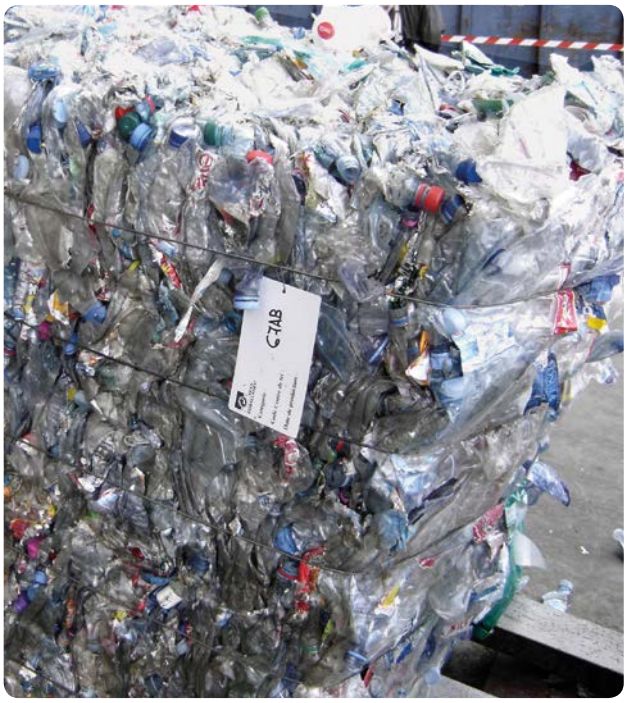
But first, what is 'prudence' in the context of waste management? First this term must be put into the context of our era. We have just recently come to realise that the Earth's resources, needed to produce the goods that we use, consume or enjoy, are not inexhaustible This depletion of resources concerns both "non-renewable" resources — raw materials such as minerals and fossil fuels, which come from deposits formed during Earth's long geological history, of which there is a finite stock — and "renewable" resources — air, water, soil and agricultural land, biological resources of flora and fauna: forests, pastures, plants and animals — but that the planet can no longer regenerate or "clean".

So far, economic growth has been based on an intensive use of resources (mineral, fossil, biogenetic, environmental), following the traditional pattern of linear production: Take, Make, Waste, wherein disposal

at end of life is the final phase (*"from cradle to grave"*). Continuing down this path is not sustainable. We must build a new relationship between humans and natural resources by trying to separate (*"decouple"*) economic growth and resource consumption. To do this we must quickly transition to a green economy, which is defined as 'low-carbon' and prudent in its use of natural resources.

Urban waste management can therefore be qualified as 'prudent' if it contributes to an optimally efficient use of resources and fits into the "loop" of the circular economy: good waste management aims to maximise the value held in municipal waste by extracting recycled materials – which will be reintroduced into the production cycle as "secondary raw materials" or used as organic amendments after composting fermentable parts of waste – or producing energy, part of which may also be considered renewable. And we would be wise to continue down that path as the recycling activity, also known as *urban mining*, can be more productive than conventional exploitation of mineral deposits: a tonne of old cell phones contains 150 grams of gold, whereas a ton of gold-bearing ore contains only 5 grams, and in addition, the tonne of cell phones contains 100 kg of copper and 3 kg of silver. Similarly, 10 tonnes of waste electrical and electronic equipment would "replace" 500 tonnes of copper ore.

Although the industry has long been accustomed to recovering some of its waste – metals and scrap, for example – to reuse them in the manufacture of new materials, the process of systematically recovering household waste is a relatively recent development: in 1992 the company Eco Emballages was founded to set up and develop the French system for sorting and recycling of household packaging. Today, more than two-thirds of the household packaging put on the market is recycled. But much remains to be done in some areas, such as recycling waste from construction and the demolition of buildings, for example.



RECYCLING PLASTIC BOTTLES
Photo: Antoine Taveneaux

The "decarbonation" of urban waste management is also gradually taking place through various initiatives: vehicles used to collect household waste are frequently updated to meet the latest European emissions standards, and hybrid or electric vehicles are being used more and more. Similarly, especially in urban areas under renovation, centralised, buried collection systems for household waste are starting to appear gradually, which will eventually put an end to door-to-door collection with vehicles and the pollution and congestion that this generates. It is also worth mentioning that 50% of the energy recovered from incinerating household waste is considered "renewable" energy because of the biomass contained in waste.

Restrictive regulations aiming to promote urban waste recovery have multiplied in recent years: European Directives, the Grenelle Environment Forum, a bill on ecological transition... and we should be pleased about this. But they would gain in coherence and effectiveness if the objectives they prescribe could be unified so as to allow for monitoring. Who today knows what the objectives of the Grenelle Environment Forum are and whether its ambitious goals have been achieved? And why are the goals that the bill on ecological transition is expected to set not defined in continuity with Grenelle's?

Still, we must persevere on this is the path of waste recovery, without underestimating the economic obstacles facing this sector, not the least of which is the cyclical price of the virgin raw material, which may discourage current efforts by intermittently concealing the inevitable trend that the price of mineral and fossil resources will increase over the long term.

Prudent does not mean "cheap" and even less "free" for the city, but let us not forget that waste management has two goals today: to protect the natural environment from the pollution that would be caused by abandoning waste without proper treatment, and to provide a supply of secondary raw materials. For the first objective, we must pay to protect our environment, and for the second, we must compensate for a transitional surcharge, as is done for renewables.

Achieving waste management that is both prudent and protected and sober: the ambition to always do better must remain intact, but at a time when the ecological transition appears to be an urgent obligation, one might dream that all sectors of activity had the same thirst for improvement and progress as shown by the management of urban waste.

THE LOUIS FARGUE WASTEWATER TREATMENT PLANT IN BORDEAUX A PRUDENT AND PROTECTED FACILITY IN THE HEART OF A NEW NEIGHBOURHOOD

by Pascal BOTZUNG, Francis LAMARQUE, Water Directorate, Urban Community of Bordeaux

When it came into service in the early 1970s, the Louis Fargue treatment plant in Bordeaux was situated on the outskirts of the urban area, but was gradually overtaken by urban development. After two rounds of modernization in 1994 and 2003, the station was brought into full compliance with standards between 2010 and 2014, as part of the DERU[5]. Special attention was paid to the water treatment system (nominal capacity of 276,500 m³/day.

Reconciling industrial goals and living environment

In 2007, while contemplating a programme to upgrade the station, moving it was brought up but quickly dismissed for technical and economic reasons.

Then the idea was given an industrial aim, a wastewater treatment plant as a form of urban anabolism, marked in particular by the prospect of building a new district (the wet docks) abutting the station, the arrival of 10,000 new inhabitants by 2030, economic activities and ad hoc community facilities.

It was understood very quickly that the plant would need to be a "zero nuisance" station (especially with regard to noise and odour, realising that achieving this goal would be difficult and precarious), and that designers should be encouraged to propose technical solutions that favour the use of renewable energy sources as much as possible. In this context, many decisions have been taken and materialised at the programme level and during the various phases of public inquiry, construction and commissioning.

Among the key:

- The desire to cover and deodorise all of the plant's structures, paying particular attention to the design of the sludge drying area and the building that houses the lamellar decanters (covered to the water), using aeraulic flow modelling for both.
- The involvement of local residents (in collaboration with the district council), well in advance of the start of construction and throughout construction and commissioning.

Open exchanges with representatives on the neighbourhood committee were thus initiated very early on to present the project and anticipate problems that could arise during the construction phase and how to handle them (night work schedules for pouring deep foundations, for example).

The points raised by local residents during the public inquiry were integrated and taken into account, going beyond the regulatory requirements (e.g., increasing the emissions testing frequency for the boilers and odour emissions).

Special tours were also organised at various stages of construction, particularly to illustrate the industrial dimension of the facilities and to educate about the implementation processes.

Finally, a group of local residents (ten volunteers selected after launching a call for participation) was assembled with the purpose of alerting the operator as soon as possible in the event they detect an unpleasant odour. This also provides a way to improve air quality in a systematic and regular manner, and be able to gather objective data on the perceived air quality.

As such, regular dialogue with local residents helps improve the acceptability of an industrial

[5] DERU: European Framework Directive 91/271/EEC of 21 May 1991 on Urban Wastewater treatment, which imposes obligations on collection and treatment of wastewater.

project like a treatment plant by reminding locals of simple principles (the station does not "produce no pollution" but concentrates and processes of everyone's waste).

- An excellent integration of an urban setting with the landscape, Louis Fargue is now situated in 1,810 ha of the largest urban centre on the UNESCO World Heritage Site list since 2007.

THE WET DOCK DISTRICT, BORDEAUX
Photo: Urban Community of Bordeaux

Subject to approval of the UNESCO Local Committee of Bordeaux, in charge of monitoring projects in the inscribed perimeter, special attention was given to the project's architectural approach. This was reflected by the desire to give the large areas around the buildings the feel of a city park, planting over a thousand trees and shrubs to help lessen the site's industrial footprint.

- Implementation of technical solutions incorporating energy efficiency targets to meet or exceed the objectives of the POPE law[6] and European Directive 2009/28/EC (use at least 23% renewable energy by 2020).

Demonstrating prudence...

Operating sanitation systems, particularly processing effluents, naturally requires energy to carry out basic functions (ventilation, pumping, heating the digesters, etc.) as well as for air purification.

Conversely, effluents and the product of their transformation must also be considered potential sources of renewable energy. As such, several sources of energy have been exploited on the site.

Renewable energy produced from biogas:

- Biogas from sludge digestion powers two cogeneration motors (537 kWe and 716 kWe), to adapt to the station's changing rates. These motors produce green electricity that is sold to the EDF (6.8 Gwh/year nominal amounting to almost € 1 million). The biogas produced in surplus during peak periods is used in sludge drying units (1.7 Gwh/year nominal). The heat dissipated by the cogeneration motors and emitted by the combustion fumes is reused for the station's internal needs (processes, heating the premises: 6.2 Gwh/year nominal).

Recovering process energy:

- The heat available after the condensation of the vapours from the second stage of the dryers is also used to heat the digesters and premises (0.2 Gwh/year nominal).

Recovering energy from treated water:

- Sanitation pipes convey water at temperatures between 13°C and 20°C throughout the year. This constantly available energy is used at Louis Fargue as part of the first project of its size. The heat recovered from the station's treated water covers 20% of the heating and hot water needs of the neighbouring wet docks district that is under construction (5,000 homes, offices, and shops). The first section has been operational since late 2014.

  The station's energy assessment has shown performance superior to regulatory objectives, with 26% of the total electrical energy consumed on site from renewable electricity (green) and 31% of the site's energy needs covered by the production of renewable energy.

[6] The Act of 13 July 2005 on Setting Guidelines for the French Energy Policy set indicative targets to cover energy needs with renewable energy sources (10% overall by 2010, 20% for domestic electricity production).

Other actions have also improved the site's prudence in terms of energ and made it possible, beyond its walls, to limit the use of potable water (drawn mainly from deep aquifers that should be preserved in Gironde):

- The choice of a process that limits reagent consumption: lamellar settling is thus carried out during dry weather, without adding reagents, which limits the amount of sludge and corresponding energy produced, and reduces the process's resultant greenhouse gas emissions.
- The establishment, by the operator, of an IS0 50001 certification for energy management, with a metering plan to equip facilities with electric meters representing 98% of total electricity consumption.
- The construction of an industrial biologically potable water production unit (100 m^3/day) that employs treated water to supply their common uses, neighbouring city cleaning services, the area's waste collection services, and operators of the sanitation service (sweepers, household refuse collection vehicles, sewer cleaners for sanitation).

Guaranteed safety?

Beyond the classic problems of potential nuisances, the expansion of urban areas around industrial facilities brings the safety of local residents into question.

In the case of Louis Fargue, the station incorporated sludge digesters and their peripherals (heating, biogas storer, flare) with the associated risks to the operating personnel from the start. Fortunately, no regrettable incidents have occurred over the years. Initial operating authorizations were nevertheless governed by the Water Act and not ICPE[7]. When the station was being upgraded, a regulatory analysis resulted in the installation receiving ICPE nomenclature classification (for the compression and storage of biogas) with an authorization scheme, as well. A thorough risk assessment was then carried out using to several risk scenarios (boiler or digester explosion, etc.), which made it possible to conclude that there were no significant overpressurisation effects (50 mbar) beyond the perimeter of the site after establishing compensatory measures (fusible surfaces on structures at risk).

An Internal Action Plan, defined by the operator, also includes all the operating procedures to be respected in order to prevent and manage risks, in particular fire and explosion; operating personnel remain the main ones exposed to risks.

Meanwhile, comments made by local residents when the project was presented during the public inquiry, although few, attest to the concern about the work, which serves as a reminder that there is industrial activity in the city.

What are the solutions to address these issues?

- Be clear in the project presentation for local residents, and take their expectations into account;
- Rely on existing representative structures such as neighbourhood committees to relay and disseminate information;
- Set a goal of having little to no risks and impact outside the plant;
- Require the operator to carry out regular crisis management exercises;
- Exceed regulatory requirements for testing and inspection and enrol in long-term testing of the operator's actions in terms of plant safety by the organizing authority .

All these measures contribute to enhancing the safety and acceptability of the site's activities.

[7] Installations Classées pour la Protection de l'Environnement (Installation Classified for the Protection of the Environment)

And tomorrow?

Maintaining facilities in the city like Louis Fargue is an ongoing challenge, as sometimes conflicting objectives must be met: implementing processes that take up little space, and therefore use intensive techniques that consume more energy; safe, low-emissivity processes to make them acceptable, progressive processes despite their compactness... so in the end more costly.

To accomplish this, must we move the plant to the outskirts of the city again, just for it to be surrounded again someday? There is no universal, transposable solution, but perhaps a few guidelines: strive for (real) energy autonomy for facilities or at minimum offset future increases in energy consumed by intensive treatment (micropollutants, etc.) with more prudent processes (when will microbial batteries be operational?); be open and help user citizens understand the issues of the service; avoid standardising processes at different installations in a territory.

Building and living in prudent, protected cities, limiting flows, better managing space and resources, rethinking the location of industrial facilities in our living environment and requiring that they be resilient and adaptable.

THE LOUIS FARGUE TREATMENT PLANT (JULY 2012)
Photo: Urban Community of Bordeaux

WASTE, AN EFFICIENCY INDICATOR IN THE CIRCULAR ECONOMY

by Thierry MAUBAN, Associate Director at Verdicité

For household waste, prudence makes sense if understood in terms of reduced quantities, but this concept has only been highlighted for the last few years. The notion of protection was not always taken into account in the past: many still recall the dioxin contamination scandal at the Gilly-sur-Isère incinerator in 2001. This naturally resulted in a certain public distrust, which today has become an obstacle for a number of projects involving treatment tools and municipal waste sorting.

For household waste, the 90s were dedicated to the generalisation of the yellow bin. Even if France was not a pioneer on the issue, even if some of the largest private operators openly showed scepticism about the projects' success and the aim of the concept, even if some of the larger cities waited until the very end the regulatory deadline to launch, driven by their own populations, in the end one must recognise that in 10 years, 100% of the French population ended up having the ability to sort their waste.

Beyond its environmental impact, this famous act of finally putting sorting within everyone's reach constituted an unprecedented step forward on many other levels:

In technical and logistical terms, the containerization aspects, collection, sorting and were immediately placed in problematic territories and strongly conditioned intermunicipalities to plan their skills, bringing the elected officials to exchange them to build and organize the city , to structure itself, to establish more partnerships with the private sector.

But also in human terms, work placement organizations have been created to satisfy the labour needs of sorting centres, whether public or private.

This sort of gesture also allowed elected officials to go to meet their constituents on a unifying theme. Because in order for the yellow bin to succeed on a micro-local level, everyone's door had to be knocked on several times, each building caretaker's voice had to be heard, landlords needed to be met, sorting guides had to be translated into foreign languages, and questions about cleanliness, good citizenship and how to live together had to be asked. We now know that the dysfunction of selective collection serves as a sign of places with other social problems, equally fundamental, that have not been addressed. As such, we were able to see that the second life given to our packaging and paper has begun to lead us naturally to a social and civic transversality by virtue of the challenge it represents for the community.

RAISING AWARENESS ABOUT THE FIGHT AGAINST FOOD WASTE IN SCHOOLS

Photo: Verdicité Bordeaux

Finally, we can speak of the evolution of individual consciousness, as we have finally offered users the opportunity to take concrete action for the environment, whose degradation is too often presented as inevitable and irrevocable. As if, after the shock of the facts and a period of denial (too long), citizens came to a stage of awareness and finally action for change, at last entering the battle and becoming aware of the power of their actions: with programmes now in effect resulting in 4.8 million tons of recycling collected annually, they are no longer powerless against the accumulation of waste.

The system still has room to be perfected, for example when we see that non-recyclable plastic resins have recently been put on the market en masse by manufacturers e.g. PE with titanium oxide, which is incompatible with existing channels, but overall the benefits of selective collection are undeniable.

In the early 2000s, we started to measure the limits of household waste recycling, and, without letting up on sorting efforts, naturally looked to the causes of the problem with *prevention*, a theme that would later be listed as a priority by the Grenelle Environment Forum in 2008.

Better than recycling which, at some point, marks the final destination of the product, even if it is to be revived later, *prevention* avoids this altogether by advocating the non-production of waste. The concept is ambitious, and much broader: to overcome the *extraction-production-consumption-abandonment* chain to function as virtuous cycles that can operate simultaneously on different planes.

Some pioneering communities that provided themselves with the means have managed to reduce the amount of waste they generate in amazing and frankly unexpected proportions, less than a third of the initial weights! The hunt for hazardous waste goes hand-in-hand with reducing amounts (in line with the 1992 Act); prudence and the detoxification of domestic refuse have therefore had a very significant effect.

The levers are varied and consist of implementing alternatives to production and consumption in a variety of often very simple ways, such as sustainable procurement, repair, reuse, pooling of certain goods, fighting waste (particularly food waste), encouraging composting, refusing printed advertisements, promoting tap water, and many others. Incentive pricing taxation on waste facilitates these efforts.

Thus, the concept of the circular economy recognises waste prevention as a mainstay: by incorporating it, for example, with the subset of *collaborative consumption*, it often provides a concrete and factual dimension because the waste is visible, we can weigh it, quantify it, calculate its cost. Its avoidance thus lends credibility to the approach, which we can then use to measure sustainability (in part: there are other indicators, such as the carbon footprint).

Here the transversality mentioned above in the case of recycling becomes the driver of the action because the subject is no longer the individual but the community, the network that, as it should, is agreed upon on a local level and thus joins the concept of territory. We have a culture of sharing and exchange based on trust between users and the principle of preponderance of property use.

Trust, exchange, sharing, communication, consultation, link. Beyond prudence, have we overlooked many safety factors? If not the equipment itself, at least the way their projects are set up? When local communities are able to demonstrate their exemplary nature, when they manage to inspire confidence, they gain the legitimate right to moderate debates and facilitate co-construction of projects that they helped advance.

Today the circular economy has gone from a notion to a concept with a much more concrete form. The "Zero Waste Europe" initiative is a testament to this. In our territory it resulted in the "Zero Waste Zero Refuse Territories" call for projects, which, in late 2014, led to 293 submitted applications and 58 territories selected by the Ministry to receive specific support. Highly anticipated benefits await, quantified in jobs created, in tonnes of carbon equivalent avoided; but waste remains a major indicator of efficiency and an excellent "target marker" in many spheres of progress that make up the circular economy, we will therefore not lose sight of this new landscape.

THE STRENGTHS AND WEAKNESSES OF AN INDUSTRIAL TOWN

INTERVIEW OF JEAN-PIERRE TURON
Mayor of Bassens, alternative resources delegate for Urban Community of Bordeaux

by Nicolas Gendreau, Urban Community of Bordeaux

Bassens, December 2014

Jean-Pierre Turon analyses the strengths and weaknesses of his commune, part of the Urban Community of Bordeaux and home to a large number of classified facilities. How do you manage this industrial image and attract residents? With architectural quality, he replies in essence.

YOU ARE THE MAYOR OF BASSENS, A CITY TO THE NORTH OF BORDEAUX ON THE BANKS OF THE GARONNE THAT IS CHARACTERISED BY THE LARGE INDUSTRIAL PORT AREA OCCUPYING ALMOST 60% OF THE COMMUNE'S LAND AREA.

The area effectively occupies 60% of the commune's territory, which is a lot indeed. Not only the size is significant, the activities taking place there are also extremely diverse. There are 25 classified establishments, including 5 Seveso plants (3 called high threshold and 2 low threshold) with problems specific to marshalling yards (cars loaded with hazardous materials) and pipelines that transport oil products, ethanol, etc.

IS THIS SPACE A AN ASSET OR A LIABILITY FOR THE TOWN?

That's complicated. If one is favourable to economic development, which is good, it is an asset. But the problem with these activities is their acceptability. The commune's Seveso plants are very old (Michelin has been here for 50 years), and hail from a time when urbanisation was viewed differently. At the time, these companies employed local people, just like the port. Changes to the types of jobs available and the requirements that go with them led to fewer local jobs being generated. Gradually residents began to feel less attachment to the site, making it less acceptable.

The 2001 business tax reform reduced the commune's revenues. Since 2001 the single business tax has primarily benefited the Urban Community of Bordeaux. We did receive some compensation. Which was appropriate. Now, with the removal of business tax, which was replaced by a multitude of taxes, we are in a different situation. This replacement with endowments generates a direct interest in the commune that is much less evident today. The benefits to the commune are not as significant. All this at a time when the public tends to question the acceptability of such companies more and more.

HOW IS THIS ISSUE OF SCALE HANDLED? THE COMMUNE'S TERRITORY IS VERY MUCH IMPACTED BY THIS ZONE, BUT ON THE OTHER HAND THE LINK WITH THE TERRITORY GOES WELL BEYOND THAT WITH THE COMMUNE.

Therein lies the complexity. That is why I said that the benefits in terms of employment and taxation were important, because these are ways of showing people that there was a clear return, voluntarily highly visible so that we do not forget this identity. Otherwise this is not acceptable for new populations. The commune's elected officials make a point of highlighting this communal identity, so that new people are not surprised. In view of the reduction of local benefits, I try to make a case for other benefits. Indeed, the compensation is not all financial. We have practically locked up nearly 20% of the territory in compensatory green lung space. The two green lungs to the south and the north are either communal property or vineyard estate. These areas are protected, i.e., construction is not allowed. The town therefore has an extremely limited amount of residual space that can be built on and no real opportunity for development.

IT IS DIFFICULT TO RECONCILE THE COMMUNE'S DEVELOPMENT WITH THE INDUSTRIAL ZONE. HOW DO YOU MANAGE?

Until now I could tell the public that the potential wealth per capita was above average, which made it possible to have above-average services and amenities. What will become dangerous is if I can no longer show that people will benefit from the existence of this communal identity. This year, our commune has been the most affected in the Urban Community of Bordeaux with a 30% decrease in operating endowment from the government. The commune is considered affluent and is sanctioned for it.

HOW DO YOU CREATE DIALOGUE BETWEEN YOUR CONSTITUENTS, ON ONE HAND TO MAKE THEM AWARE OF THESE ISSUES, AND ON THE OTHER HAND INDUSTRIALISTS, SO THAT THEY PARTICIPATE IN THE DEVELOPMENT AND LIFE OF THE COMMUNE?

I have been in office, in positions of responsibility, for more than 30 years. In each of my verbal and written interventions, mindful of economic development, I have laid all the issues out on the table.

For example, over 25 years ago we were given the opportunity to build a hazardous waste incinerator. At the time it was a hotly contested controversy, but the municipal council decided to accept the project. The facility has demonstrated its usefulness, and what is more, to date there have been no major incidents and it employs 100 people.

AND DO PEOPLE TODAY ACCEPT THIS CHOICE THAT IS NOW INTEGRATED INTO THE LANDSCAPE?

Yes, but under the condition that efforts be made in terms of safety and limiting nuisances.

In November 2007, a project to dismantle the ship Le Clémenceau in Bassens was being considered. Elections were to be held in March 2008. The project appealed to me, it seemed worthwhile. I supported it. In a public presentation meeting, after a tense beginning, the public accepted it in view of its stakes for the territory. This was sufficient to determine that there was interest in Bassens as one of the potential sites for dismantling ships. Today, the ship La Jeanne d'Arc and soon the Colbert will be dismantled in Bassens, under strong environmental requirements.

ALL INDUSTRIAL EQUIPMENT IS NOW SUBJECT TO A NUMBER OF STANDARDS AND CONSTRAINTS, BUT DESPITE ALL THIS THERE IS STILL A RESIDUAL RISK OF ACCIDENTS. JUST NOW YOU MENTIONED ACCEPTABILITY. TODAY, DO YOUR CONSTITUENTS STILL ACCEPT THIS RESIDUAL RISK DESPITE THE EFFORTS MADE BY INDUSTRIAL INTERESTS?

I became mayor in March 2001. That year was marred by two disasters: the towers in New York, and a few days later, the AZF explosion in Toulouse. The 40 ha. Pomme d'Or district in Bassens lies opposite the Michelin plant. Within 48 hours of the AZF explosion, I organised an informal meeting in a small room to meet with the public. It was not a public meeting, but a meeting for people to express themselves. A lot of people worked at Michelin and knew the seriousness of the company. They knew that safety was culturally rooted, which is not necessarily the case elsewhere. There were of course opponents, but they were a minority.

What is paradoxical in the industrial zone is that the issue of security (apart from very violent incidents) is not what generates anxiety, but rather the problems of nuisances. Although undoubtedly these nuisances cannot compare to those

20 years ago. Considerable progress has been made in terms of noise and smells. But fewer and fewer people in the commune work in the industrial port area, new people arrive and the perception of environmental problems is different than in the past.

To address concerns about air quality, we set up a small communal measuring station that is now part of the AIRAQ network. Results are released regularly. Overall, industrial pollution is less pronounced now than pollution from transport and automobiles. Then we told ourselves we had to go further. The town therefore set up a monitoring committee, an informal organisation dependent on the district council with some elected officials, members of associations and individuals to exert a degree of vigilance. Businesses play the game in the interest of all the stakeholders. If there is any kind of incident, a person from the monitoring committee visits the business in question.

ARE YOU NOW CONFIDENT ABOUT THE FUTURE DESPITE THE FACT THAT PEOPLE ARE INCREASINGLY SENSITIVE TO POLLUTION AND SECURITY ISSUES?

Overall, yes. For the ship dismantling projects, the media and associations advised the public that the local environmental component should not be the only factor taken into account. Is it normal for ships to be dismantled in unclear circumstances in India, rather than locally under controlled conditions, requiring that things go well. There may be counter-arguments to this. Now when we say that waste is a resource and that it is not negative, the activity is positively perceived and valued. For two years technology and research has been developed. We are now perceived as an area focused on innovation.

To get back to the water and sanitation services, in Bordeaux there is a wastewater treatment plant called Louis Fargue that is right at the heart of the city. This work is an example of an industrial facility in a residential area. You were heavily involved in the renewal of this wastewater treatment plant. What do you think about the future of a facility of this nature within an urban area, based upon your experience in Bassens?

The location of the facility must be rational in relation to its function. This does not mean laying a pipeline over several kilometres to move the station further away, as being further away without considering travel distances creates the same problem. If we create a facility on the outskirts, several years later, subdivisions would be created nearby. Moreover, this type of station is not very dangerous.

BUT THE NUISANCES CREATED CAN BE SIMILAR: NOISE, ODOURS.

I believe it is absolutely vital that these facilities that were on the outskirts of the city and are now in the city are not moved. I think that would be a mistake and that we would lose touch with reality. A city is not just housing, museums, and performances. It is also a place for activity. There are two areas that must not skimped on: noise and odour. A permanent struggle to reduce nuisances should be continued, as noise and odours should no longer be a part of our era. So the financial trade-off of not moving is that we must constantly be looking for ways to improve.

INDUSTRIAL FACILITIES, ALTHOUGH MORE AND MORE EFFICIENT IN HANDLING THESE NUISANCES, CAN UNFORTUNATELY SOMETIMES FAIL. THIS GOES FOR INDUSTRIAL PLANTS SUCH AS MICHELIN AS WELL AS FOR WASTEWATER TREATMENT PLANTS. AND FROM TIME TO TIME THERE ARE ODOURS, AND SOMETIMES THERE IS A LITTLE NOISE. WHICH THE PUBLIC HAS A HARD TIME ACCEPTING AS IT IS NOT USED TO HAVING TO DEAL WITH THESE NUISANCES. A SMALL INCIDENT CAN QUICKLY HAVE VERY SERIOUS IMPLICATIONS.

I know, but I think it is also the responsibility of everyone involved; it is the responsibility of the media, and politicians. We want to live in a world that is sanitised, so sterilised that we will have more people who are dissatisfied. I am convinced that in seeking absolute perfection, we forget about the infinitely greater dangers.

Is relocating the plant not more serious than a quarter-hour of unpleasant odour from time to time? I am, of course, not talking about security per se, where the risk would be too great.

Finally, if possible, industrial equipment should be given a touch of architectural style.

COMMUNITIES ARE INDEED SENSITIVE TO FACILITIES' ARCHITECTURAL INTEGRATION WHEN CONSTRUCTING WASTEWATER TREATMENT PLANTS. BUT IS THIS ALSO TRUE ON THE INDUSTRIAL SIDE?

That's more complicated but it is happening more and more. Industrial beauty is possible. Industrial tourism is becoming increasingly important. Requests to visit industrial sites are increasing. Bit by bit we can walk from one end of the industrial port zone to the other via footpaths and easements with some protected natural spaces. A mixture of nature and industry is indeed possible.

LASTLY, DO YOU HAVE ANY SPECIAL RECOMMENDATIONS FOR THE INCLUSION OF PRUDENCE AND PROTECTION IN MAINTAINING WATER, SANITATION, AND ENVIRONMENTAL SERVICES?

The architectural gesture is as important as education. The undeniable example is the wastewater treatment plant Clos de Hilde in Bègles, to the south of Bordeaux. Louis Fargue would not have been as well accepted without the success of Clos de Hilde. I think we should aim to drop all reservations about what it is to be industrial.

It is necessary to take into account the issues of risk and pollution and treat these subjects as beautiful objects in the city and display them as an integral part of the landscape.

There must be maximum transparency, we must not hide anything. We must show that it is visible and a pleasure to see the equipment. Psychologically this reassures people, and apprehension is to be avoided. During Heritage Days, we see that the issues of water and sanitation interest people, particularly in the territory of the Urban Community of Bordeaux; many architecturally interesting buildings are in progress simultaneously.

Finally, companies must behave like upstanding citizens, in mindset and in practice. Unfortunately the financial aspect when building is still too significant. Industrialists must think about the long term. Companies also absolutely must demonstrate that they are undertaking a sustainable development approach in order to improve how they are viewed by surrounding populations.

Companies that show that they are prudent and offer protection will naturally be accepted by the public. Political actors must be absolutely firm on this point.

THE BASSENS INDUSTRIAL PORT AREA
Photo: Bassens town hall

THE "AGENDA 21" PLANS, TOOLS FOR MOBILISATION AND ACTION IN FAVOUR OF SUSTAINABLE CITIES: THE EXAMPLE OF LE SÉQUESTRE

INTERVIEW WITH GÉRARD POUJADE, Mayor of Le Séquestre, Regional Councillor for Midi-Pyrénées, President of the ARPE Midi-Pyrénées

by Nicolas Gendreau, Urban Community of Bordeaux

Le Séquestre, December 2014

YOU HAVE BEEN HEAVILY INVOLVED IN SUSTAINABLE DEVELOPMENT ISSUES FOR QUITE SOME TIME. YOU INITIATED ONE OF THE FIRST AGENDA 21 PLANS, AND NOW PRESIDE OVER THE SPL ARPE MIDI-PYRÉNÉES, A REGIONAL AGENCY THAT IS HIGHLY INVOLVED IN SUSTAINABLE DEVELOPMENT IN THE MIDI-PYRÉNÉES REGION. WHAT WERE SOME OF THE ASPECTS OF YOUR INVOLVEMENT? WHAT WAS KEY TO YOUR PERSONAL AWAKENING? WAS THE RIO SUMMIT IN 1992 SIGNIFICANT FOR YOU, AND IF SO, WHY?

Rio was certainly one of the elements but not the only one. When I became mayor in 2001, the municipality wanted to involve residents and village associations in the implementation of the various projects so that they were compatible environmentally, economically, and socially. At the time, the municipality did not know about "Agenda 21". These projects, unknowingly, had characteristics of Agenda 21.

Inadvertently, pushed by its citizens, the town had initiated a project involving the principles in Agenda 21.

The municipality's Agenda 21 was drawn up in 2003 and deliberated in 2005. Two years of writing were necessary.

TODAY, WITH 10 YEARS OF HINDSIGHT, DO YOU CONSIDER THIS APPROACH TO HAVE BEEN EXTREMELY POSITIVE, AND HAS IT HELPED TO IMPLEMENT A NUMBER OF ACTIONS AT THE COMMUNE LEVEL?

This approach has changed the commune with regard to urban planning and how the commune has flourished, the social dimension of the establishment of relationships with associations, and an interface for field procedures. The town has created an eco-conditionality of aid to all associations based on a project shared between associations and the commune.

This project is renegotiated every year with each association. Thanks to Agenda 21, the commune was the first to set up a progressive social water pricing system.

In 2002, in the early beginnings of what would become Agenda 21, we wanted to take advantage of the commune's flat layout, which led to the establishment of a bicycle plan. In 2003/2004 the commune wanted to set up a ten-year plan for cycle paths to make sure that 40% of the commune's roads and streets would have separate cycle paths. Today, 10 years later, this is the case. This changed the commune's appearance, and also the way we do politics in the area.

CYCLE PATH IN THE COMMUNE OF LE SÉQUESTRE

Photo: Le Séquestre town hall

IF WE WERE TO ZOOM IN ON THE ISSUE OF PRUDENCE, IN PARTICULAR LIMITING THE STRESS ON WATER RESOURCES, THE CONSUMPTION OF URBAN SPACES, OR WASTE REDUCTION, HAVE THERE BEEN SIGNIFICANT ADVANCES IN THE COMMUNE OF LE SÉQUESTRE?

The most significant advance was the progressive social water pricing system. It is extremely effective in terms of prudence.

A general reflection on the principles of Agenda 21 with regard to green spaces was carried out to determine the different factors from an aesthetic, economic, and ecological point of view, and thus significantly reduce associated costs (creation costs, labour, raw material expenditures, maintenance and watering).

This overall prudent approach is adopted on all projects and guides our behaviour right from the preliminary design phase. It is necessary that all the dimensions (social, environmental, economic and governance) are taken into account from the outset, whatever the type of project. Creating working groups fosters fruitful, meaningful discussions and leads to setting up innovative municipal projects that are often efficient in all areas.

AGENDA 21 DATES BACK TO 2005. TEN YEARS IS OLD. WHY NOT DRAW UP ANOTHER?

To date, a new Agenda is being started in my commune, with goals set for 2025 that will be divided into 4 areas:

- By 2025, this territory must become an energy positive territory, consuming less, behaving differently, and by then we will have set up the means for renewable energy generation.
- By 2025, reach zero non-recycled waste (implementation of a shared associative communal garden with a chicken coop so that the public can bring organic waste for the hens to eat), generalisation of behaviours to so as to reduce waste to a minimum.
- By 2025, offset the effects of anthropogenic activity. We must be a territory that offsets its CO_2 emissions so that we have as little impact as possible on global warming.
- By 2025, be a zero poverty territory, i.e., no one with negative disposable income. This is another reason for the shared garden, as it is intended to be open to people who are most in need. A shared garden that is accessible and free, with a market gardener who will be hired for this purpose.

This is a new generation of Agenda 21, which is called the ARPE "Agenda 21 Horizon 2025". A somewhat catchy name, A21 H25. But the goal is that it goes viral. The contents of Agenda 21

must be comprehensible to the public. And to positively involve the population, we must explain that the commune has goals for waste management, energy, carbon activity, biodiversity, and poverty. The municipal councillors from Le Séquestre have a perfect knowledge of Agenda 21 and its contents which is not always the case for territorial elected officials.

YOUR PROPOSAL FEATURES FOUR PILLARS OF SUSTAINABLE DEVELOPMENT.

We have established several consultation and participation bodies. With these bodies, we bring together the 40 chapters of Rio, Lisbon's Millennium Development Goals, and the five aims of sustainable development today. With this you cover absolutely everything.

YOU HAVE VERY STRONG VIEWS ON THE ISSUES OF PRUDENT ENERGY USE, CO_2 EMISSIONS, AND ACHIEVING ZERO NON-RECYCLED WASTE. BUT WHAT ABOUT NATURAL RESOURCES, ESPECIALLY WITH REGARD TO WATER AND THE "PRUDENT CONSUMPTION OF SPACE"?

Are you familiar with the negawatt theory? It states that three things must be done in the following order:

- adopt a different mindset toward energy: we start by saving
- make investments to consume less: insulating houses, installing low consumption light bulbs in street lights, etc.
- use renewable energy for unavoidable energy expenditures

This theory, *behaviour, investment, change* is not only true for energy, it applies to everything. Increasing biodiversity offsets space consumption.

My commune's PLU (local urban planning scheme) was the first in France to reduce building land. Agenda 21 explains that biodiversity compensation contributes to managing space consumption.

A commune's PLU must make sure not to use more space than can be offset by biodiversity compensation, if there is not enough space to do so. In Le Séquestre, we aim to achieve full biodiversity offset by 2025. Therefore if we consume space, we put ourselves in a tough position to meet these objectives.

Regarding offset for water, fertilizer, and phytosanitary products, we typically achieve zero non-recycled waste. Here, phytosanitary products are considered waste because, in the truest meaning of the term, they constitute waste for the commune. So it is something that incorporates everything and all resources.

INDEED, THIS APPROACH CAN FOCUS ON MANY AREAS, BUT ESSENTIALLY WHAT YOU ARE PROPOSING IN YOUR APPROACH IS A "COMMUNE-BASED APPROACH". YET THESE ISSUES BRING UP QUESTIONS OF SCALE AND INTERDEPENDENCE BETWEEN TERRITORIES. WHAT APPROACH SHOULD BE TAKEN WHEN AN ISSUE IS RESOLVED AT A GIVEN LEVEL AND CAN BE APPLIED TO ANOTHER LEVEL AND VICE VERSA?

This approach applies to all levels of the territory.

A Occitan proverb states "broc broc ça fagote" – (the bundle is made branch after branch). As mayor of a commune, I am part of an urban community. The concern, with regard to the political goals I have set for the commune, is to be coherent with the various levels of territories and see how I can work in the same direction. My commune is part of an urban community, which is part of a department, which is part of a region, which is part of a state, which is part of Europe. If I wait for Europe to issue a European Directive to guide my approach, I will be out of touch with the everyday urgent needs that must be attended to in my community. We must not wait.

Specifically, thanks to the generalization of several actions on the part of my commune's citizens (anti-junk mail campaigns, water-saving devices, etc.), we are moving forward and making a contribution. It is important to explain the meaning of every citizen action and their aims in order to multiply their effects If we do not, we can hardly complain about what others have not done. I do not wait, I act on my level.

BEYOND THESE QUESTIONS OF PRUDENCE AND SUSTAINABLE DEVELOPMENT, WE HAVE INCREASINGLY STRINGENT REQUIREMENTS ON LIMITING THE IMPACT OF TREATMENT PROCESSES (TREATMENT OF THE AIR, WATER TREATMENT OR TREATMENT OF WASTE), AND HAVING TREATMENTS THAT ARE INCREASINGLY EFFECTIVE OFTEN RESULTS IN HAVING PROCESSES THAT DEMAND MORE AND MORE ENERGY OR SPACE, OR EMIT MORE CO_2. HOW CAN THESE CONTRADICTIONS BY RECONCILED? CAN THE NEW GENERATION OF AGENDA 21 (A21 H25) PROVIDE SOME ANSWERS?

We are indeed subject to the rebound effect. When you implement energy saving devices, the community's buying power increases, people buy more computers and consume more electricity.

The means of reacting to the rebound effect is a very complex subject, because our society is not frozen in time. Clearly, the field of energy is always changing and is much different today that it was 20 years ago— today I have to manage the electricity for several tens of millions of smartphones and tens of millions of tablets that did not exist back then. This contributes to the rebound effect.

As for water resources, today when you build new there is an anti-rebound effect, i.e., that thanks to progress, water-saving devices are efficient from the start. The more I build, the more water I save, hence the anti-rebound effect. Accurately measuring both is extremely complicated. There is no rebound effect for water consumption. When water-saving devices or progressive water pricing are implemented, we save a few dozen Euros per year. There is no room to see a rebound effect.

Getting back to energy, where the effect is most visible and where the rebound effect may be good news: people save money and will therefore be able to spend on other things, that is to say that they are living a bit more comfortably. I cannot say whether this comfortability generates well-being or not. The goal, from my point of view, it is not only to generate gross domestic product, but also to generate well-being. Today, Agenda 21's new sustainable development approaches incorporate this new ambition: to develop the concept of well-being in our communities.

DO YOU THINK THAT TODAY WE SHOULD USE WELL-BEING INDICATORS AS TOOLS TO GUIDE OUR PUBLIC POLICIES RATHER THAN THE CONVENTIONAL MACROECONOMIC INDICATORS YOU MENTIONED SUCH AS GDP OR ANOTHER MEANS?

It is not 'or', it is 'and'. We must not dismantle existing knowledge. GDP was invented by a Belarusian who immigrated to the United States during the interwar period. His concept is useful and quite helpful, but the welfare indicator is, too. We must aggregate all the knowledge that produced these types of indicators. There is no close link between the public's happiness index and the economy that goes with it. Bad news for the economy results in a drop in happiness. But very poor countries have rates of well-being or feelings of well-being, in some places, which are far higher than some more developed countries.

TO CONCLUDE OUR DISCUSSION, DO YOU HAVE ANY RECOMMENDATIONS OR TIPS SPECIFIC TO MANAGING WATER, SANITATION OR ENVIRONMENTAL SERVICES THAT WILL HELP THEM FOLLOW YOUR APPROACH?

The progressive social pricing system, used for water as well as sanitation, also works well for household waste. If we had a weight-based pricing system for what we throw away, it would be highly effective. The idea is that we must stop taxing more, and instead tax differently. Everyone must understand the intelligent application of the pollute/pay principle. We must make it so that there is less to throw away. We must make consumers and users aware of their responsibilities.

GRENOBLE, AN ECO-CITY IN THE ECOLOGICAL TRANSITION

by Vincent FRISTOT, Deputy Mayor of Grenoble, in charge of Urban Planning, Housing, and the Energy Transition

Grenoble was one of the first cities to commit to the "eco-cities" programme, in line with a set of actions and schemes already underway in the territory, such as the "Mur Mur" ("Wall Wall") assistance programme for thermal insulation of condominiums (5,000 units), or the new De Bonne district, recognised as a pioneer in all aspects of sustainable cities: social, economic and environmental.

The development of the new Presqu'Ile ZAC (business district) to the northwest of Grenoble continues this momentum. Several of the projects being carried out there are part of the eco-city approach and are supported by the national programme for investments in the future, part of the "City of Tomorrow".

Today it is widely recognized that climate change has begun, which calls for appropriate public policies, at the global level (UN programs and agreements) and at the level of local municipalities and territories. This means building low-carbon cities, preparing for the depletion of fossil fuels and eliminating nuclear risk.

Moreover, the economic crisis is affecting a growing number of households (more than 3 million households suffer from fuel poverty in France according to the National Agency for Housing Improvement), which adds to the urgency of reducing the costs related to energy consumption. The sectors of building and mobility are the two main energy consumers and are therefore the major levers for committing to the energy transition process.

30% below thermal regulations for housing, specific to ZAC Presqu'Ile

The thermal quality of new buildings is the subject of particular attention. Design plans must consider the "life" of buildings over time, over several decades, because this will determine the energy expenses of future occupants and the environmental impact of the energy consumed.

As such, construction operators (contractors and developers of social housing agencies) have been asked to raise the level of building insulation, reducing heat loss to 30% below the limits authorised by the regulations (RT2012). The goal is to prepare these actors to produce passive buildings with very low energy consumption by 2020.

For ZAC Presqu'Ile, special care is given to the buildings' envelope, heat pumps coupled with the groundwater table that deliver hot water and water for underfloor heating result in an energy efficient heating solution (COP coefficient greater than 6). Moreover, in summer, cooling is provided by groundwater in the floor itself, which is very energy efficient.

The additional costs of enhanced insulation and more efficient ventilation are offset by subsidies to contractors, thanks to the eco-city program.

Active street lighting

Street lighting is an essential component of the new urban neighbourhood. Implementing LED lamps makes it possible to change colours, adjust intensity based on the time, and for some streets, activate full power only when motion is detected.

These new devices reduce light pollution through thoughtful design and significantly reduce public lighting energy costs.

Smart multi-fluid meters

The large-scale deployment of smart electronic meters entails an experimental phase. The ZAC Presqu'Ile is an opportunity to specifically monitor energy and water consumption in order to verify that the energy prudence goals have been achieved. The ZAC's developer will have agglomerated data on fluid consumption per island or area, to better dimension the networks in future developments. The goal is also to provide residents with detailed information on their consumption. These measures will make it possible to evaluate the project, detect possible anomalies, and make the necessary adjustments for future operations.

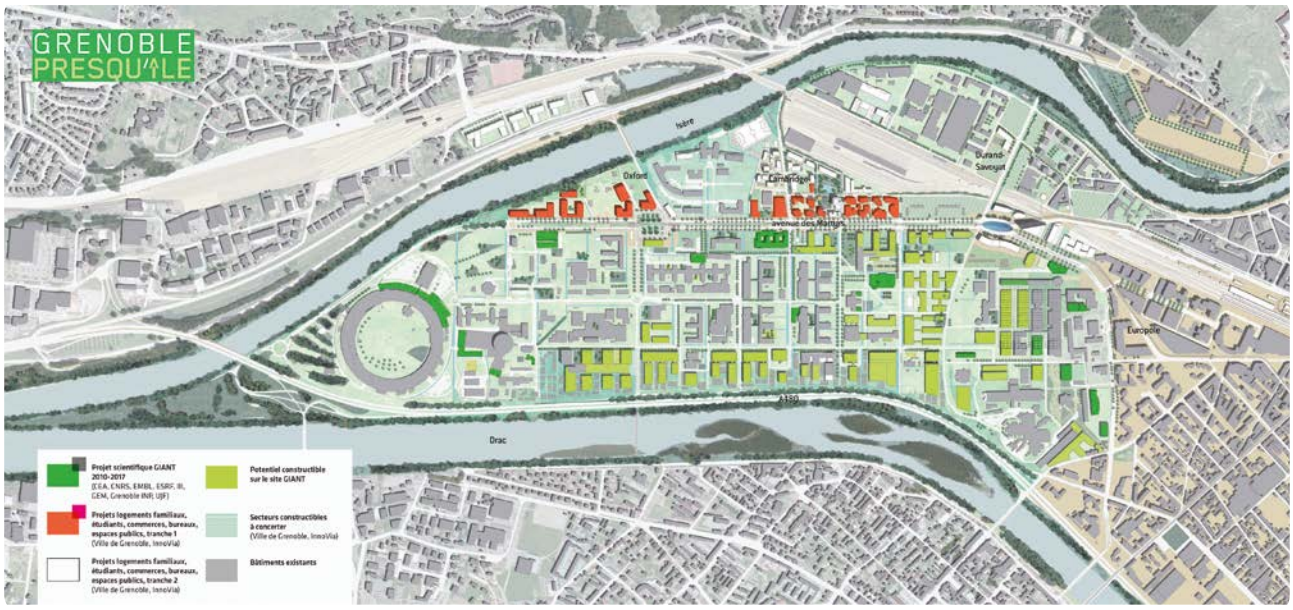
New shared multimodal transport

The residential area (1,000 future units) is built along the recent extension of line B on the area's tramway. The tram's central station, "CEA Cambridge", will have a silo car park called the "Transport Pavilion", which will combine the following public transportation facilities in one place: day parking for activities, overnight parking for residents, bike parking and Métrovélo bike station, and car-sharing vehicles.

A transport pass service with a single bill and a single card for all these modes of travel is key.

Through these various efforts being carried out in the ZAC Presqu'Ile in Grenoble, we can see that the city of tomorrow is underway: much more prudent with regard to energy, enhanced comfort for users, and reduced costs for residents.

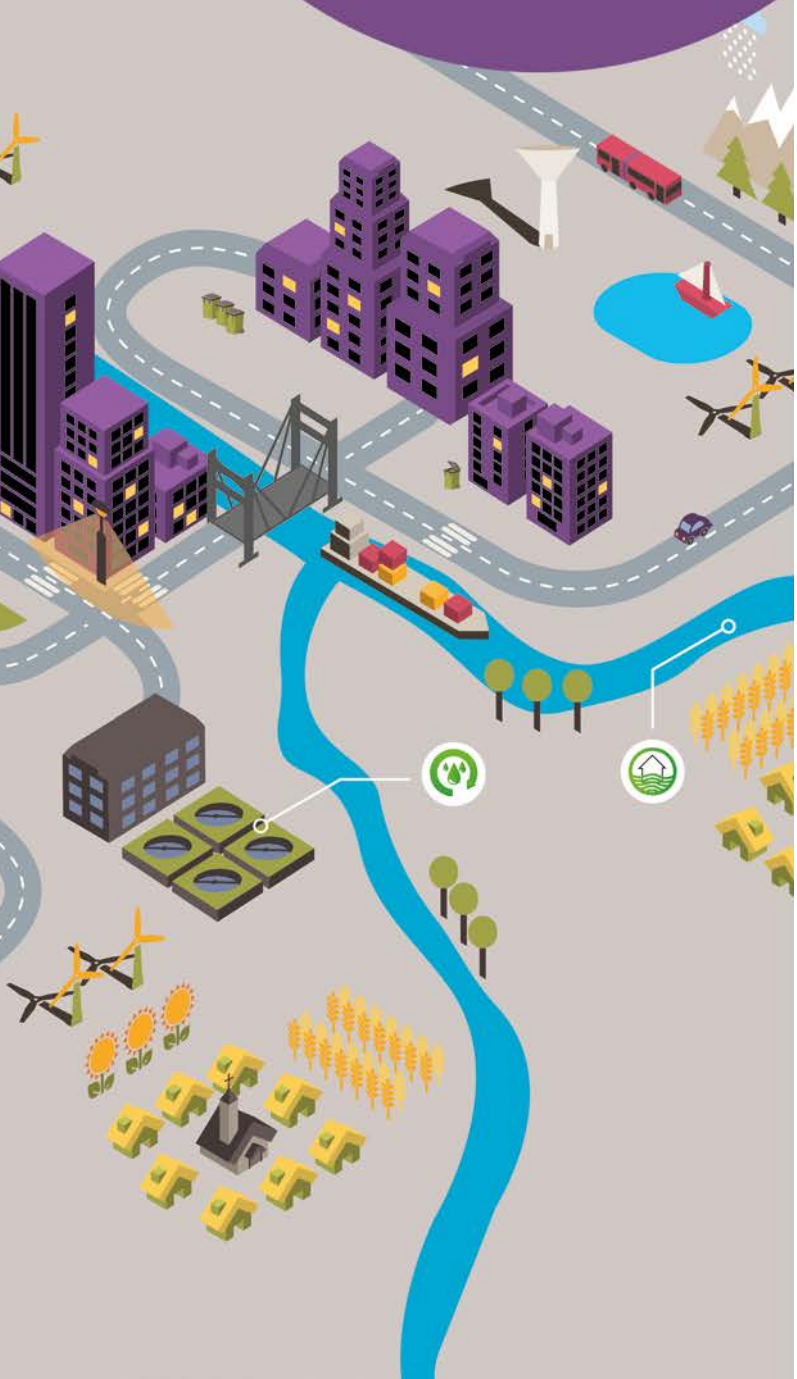
To build and develop future sustainable neighbourhoods, the new municipality wished widely involve residents and citizens in the process.



MASTER PLAN FOR THE GRENOBLE PRESQU'ÎLE ECO-CITY PROJECT
Source: InnoVia / Agence de PORTZAMPARC

CHAPTER 2:

THE RESILIENCE OF CITIES AND MUNICIPAL SERVICES



Faced with needs in terms of prudence and protection, urban territories and cities are implementing adaptation strategies. While natural hazards are growing, numerous options for making cities and territories Resilient are being discussed. Many solutions are available. These vary greatly and are probably specific to each territory and each challenge. Solutions are transversal, are applicable to the environmental, economic and social aspects and a technical solution is often not the most appropriate.

After providing a definition of the resilience of urban territories, Clara Villar emphasises the benefit of dealing with urban issues through her lens. These issues lead us to question the traditional concepts and make it possible to find additional solutions between sustainable development and resilience. In particular, the challenges of the long and short term, of prudence and protection, and of individuals or society, are mentioned.

p.59

Marie-Noëlle Pons offers a summary of global disasters: a typology of the disasters is given, the number of disasters in 2013 and the number of disasters since 1900 in Europe. And even though climate change does not explain the evolution in the number of natural disasters, the United Nations office for disaster risk reduction (UNISDR) would welcome and is fighting for reduction, culture and prevention of risks. The examples of the earthquake in Chile in 2010, the earthquake in New Zealand in 2011 and the anticipation of the Big One in San Francisco lend substance to the discussion.

p.64

Anne Charreyron-Perchet mentions resilience strategies to implement, in particular for vulnerable territories, whose vulnerability appears to be an asset in facing disruptions. The levers to use include the development of the territories' resources, the ability to mobilise local players, the link between the territorial and temporal scales or the implementation of integrated strategies. Finally, regardless of the territory's vulnerability, whether it is environmental, economic or social, a political commitment seems essential.

p.70

After addressing the resilience of urban systems, Caty Werey et al. suggest an approach to the resilience of potable water networks. They define the vulnerability of a system through structural (infrastructure), operational (users), and external (externality) vulnerability. They give an overview of the research projects that have become involved with these issues: SMART-Online CARE-W, CARE-S, ANR INDIGAU and Resi Water, which is still ongoing. A project on the notion of resilience will make it possible to suggest curative or preventive solutions to be implemented on a potable water network.

p.74

The Paris metropolitan area is exposed to the risk of a major flood, at a very high cost for a reference year such as 1910: 30 billion euros. Magali Reghezza-Zitt describes the impacts that such a disaster could have, both on the territories affected and beyond. And faced with this observation, solutions can be found, particularly thanks to a resilience strategy put in place by the government: a crisis acknowledged, but not experienced.

p.77

Marie Toubin's interests lie not in resilience but in an urban territory's conditions for resilience. Here too, with the example of the Parisian context, and in particular the various levels of flood risk management, she shows the importance of operators and network project managers (water, gas, electricity, municipal heating, etc.) working collaboratively. Interdependence between the various municipal services in the Paris region is critical for continuation of service, and strategies that are too isolated are likely to cause problems for all players if there is a major flood.

p.80

The industrial world has long since put in place tools and methods for managing risks. Olivier Dufaud suggests applying these principles, which have often been proven, to cities and territories. After defining the notion of risk, the inherent safety used in process industries is described according to four principles: minimisation, substitution, simplification and moderation. Through numerous examples, the application of these principles is examined in the context of cities and territories.

p.85

Valérie Emphoux, manager of the "Rainwater" department for the town of Antibes - Juan les Pins, shows concrete examples of the actions put in place to reduce flood risks. After being affected several times by severe flooding, the town of Antibes-Juan les Pins has developed a risk-management strategy. Drawing on a very interesting description of the events, the actions put in place are described, with a special focus on the challenges of acceptance by the citizens.

p.90

URBAN RESILIENCE, SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE: NEW PERSPECTIVES?

by Clara VILLAR, Director of Resilience and Crisis studies, Cerema Territories and Cities Technical Division

Cities are required to anticipate both gradual evolutions and abrupt shocks. Using a few examples - Feyzin, the Roanne Area, the Le Mené community of municipalities, a complementary approach to resilience and sustainable development makes it possible to provide solutions to the hazards of climate change.

Today, the urban consequences of disruptions associated with climate change are difficult to define accurately and are not easily addressed by local players. This is mostly due to the uncertainty that is inherent in scientific knowledge and in the difficulty of specifying the consequences accurately enough at a territorial level that is conducive to action. It is also due to the persistence of sectorial practices and approaches, which do not make it possible to understand the issues globally and systemically, and which encourage entry using tools, and not through local projects.

Under these conditions, how is it possible to meet the goals of local sustainable development, combining in particular, prudence and protection?

The concept of resilience, applied in various disciplines and, since the 2000s (Campanella, 2006), in the context of the city, seems to bring renewal in terms of actions, professional practices, and power sharing. In this uncertain and changing context, resilience seems pertinent for addressing the issue of cities responding to climate change, and more generally to disruptions of any kind, with a view to sustainability.

What is urban resilience?

Without going back to the history of the concept[8], we are suggesting a definition of what a resilient city could be. This definition is deliberately general in scope so that it can be adapted to the various types of shocks and mutations. A resilient city is a city in motion, a city that is able to:

- anticipate disruptions, abrupt or gradual, thanks to surveillance and forecasting
- lessen the effects of these disruptions
- overcome and bounce back, thanks to learning, adaptation and innovation
- evolve towards a new state of dynamic balance, while preserving its functionalities[9]. This state is selected and constructed democratically.

CHINESE PORTRAIT OF RESILIENCE

If resilience were...

a tool: a Swiss army knife
a body part: a joint
a colour: polychrome
an adjective: plural
a state: dynamic balance(s)
a musical instrument: an orchestra
a quality and a flaw: easily swayed
a plant: an ecosystem
a place: interfaces
an object: a ball of wool (*see the web of resilience in permaculture*)
a game: a trampoline

[8] On this point, see "Résilience : repères chronologiques " ("Resilience: chronological benchmarks") (C.Villar, 2014, http://www.territoires-villes.cerema.fr/resilience-reperes-chronologiques-a1436.html

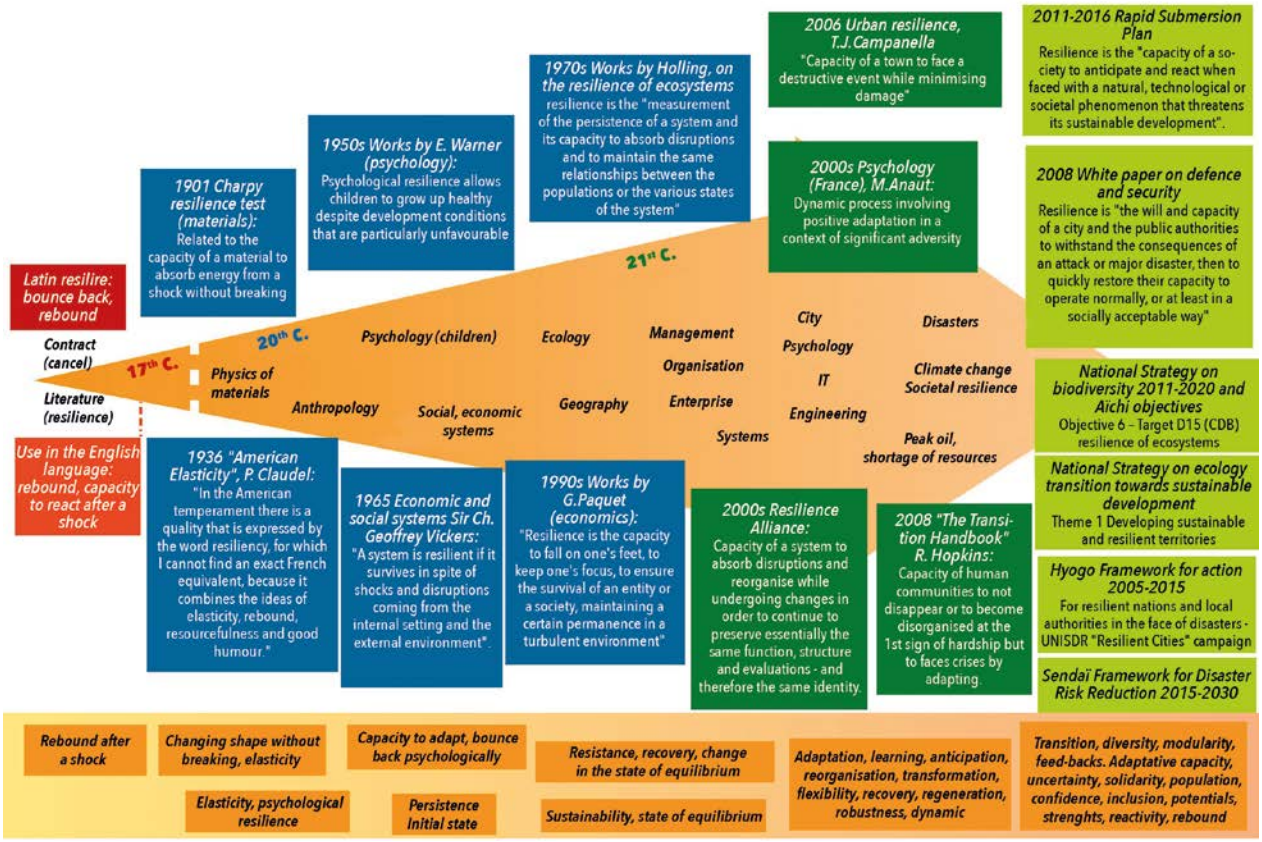
[9] Here, functionalities are not limited to the technical domain, and include the social and relational aspects.

The search for resilience mobilises levers that allow the city's players to rediscover the ability to act where traditional methods of action are at their limit. It involves searching for dynamic balance between paradoxical characteristics and contrasting processes: short term and long term, on a local scale and globalisation, redundancy and efficacy[10], tailor made and ready-to-wear, autonomy and dependency... It seems that studying resilience must also involve seeking balance between a systemic "meta" analysis that once again places the territory in global dynamics, economic dynamics in particular, and an "infra" approach by territory on a smaller scale (living area, for example).

Briefly, the search for resilience can be based on several themes, such as the link between the scales of time and space, setting up surveillance, anticipation and forecasting, diversity and the quality of the links between players, and the development of the ability of all stakeholders to take action.

Mobilising urban resilience, for what purpose?

The urban issues to be addressed from the point of view of resilience are many, and can be artificially divided into two categories: shocks and gradual disruptions. The strategies developed in response are extremely varied in both cases: educating the population in the areas at risk, using new information and communication technologies (NICTs) in crisis management, developing access to digital services, community urban agriculture and local food channels, local heritage and culture, art and microbusinesses, "alternative economic practices" (Castells et al, 2012), development of sectors, educational projects, cooperative actions, the functionality economy[11], etc. Plenty of examples show that the initiatives are invigorating, give a large share to the population and are based on "self-sufficiency, altruism, exchange and cooperation" (Castells et al, 2012).



RESILIENCE: CHRONOLOGICAL BENCHMARKS (NON-EXHAUSTIVE DIAGRAM) C. VILLAR (2014) CEREMA

[10] In the economic sense

[11] Economy that favours the use rather than the possession of goods

Climate change mobilises both categories of events: evolution over a long period of time, insidious and sometimes impalpable on a daily basis, and abrupt climatic events that can accompany climate change. In this context, a strategy of resilience, which allows for the occurrence of disruptions, makes it possible to take action in spite of the uncertainty that characterises most of the knowledge, by developing the ability to bounce back mobilising robustness, flexibility, anticipation and responsiveness. Such a strategy also makes it possible to seek a balance between solutions based on "hard" constructive mechanisms, and environmental solutions based on mechanisms that are exclusively natural.

The Le Mené community of municipalities, located in the centre of Brittany, has been set up on the basis of a shared territorial project that offers meaning: energy independence by 2030. The diversity of actions is explained by the consistency of the territorial project, based on clear, limited objectives, by the commitment and participation of the population and the socio-economic players thanks to the establishment of strong relationships based on trust - linked to the very strong identity of this territory and the shared culture -and by the conviction of having access locally to the capacity to bring about change.

Which are the factors for improving the resilience of territories?

Several factors appear to contribute towards improving a territory's capacity for resilience, such as "connected autonomy"[12], the diversity and redundancy of the elements and functions, modularity, direct feedback, fine-scale invigorating initiatives to encourage the involvement of individuals, surveillance, anticipation and experimentation, inclusiveness (in the sense of a wide distribution of power), inclusion in the territorial setting (history, culture, structures, dynamics), links and trust between players, the meaning given to the action, social capital (strength of social networks, connections, etc.) and the development of capabilities[13], innovation and creativity, connections between the levels, etc.

The challenges of prudence are to be brought closer to resilience as used in permaculture, based on diversity, connections, creativity and the optimisation of flows[14]. Cities in Transition (CiTs) are planning for the convergence of the petroleum peak and climate change as they design and construct their future, based on individual and collective prudence, the resilience of territories, the strengthening of links and solidarity between players, learning and the development of the ability to take action.

In terms of safety, feedback highlights the importance of taking into account all the aspects that make up a territory (political, social, economic, environmental, historical, cultural, relating to heritage, etc.), including in the area of disaster prevention. Setting up surveillance and alerts, taking into account phenomena at various levels and their domino effects, the quality of the relationships between players in prevention and crisis management, and the involvement of the population are essential for improving the management of the events, reducing their duration and encouraging the territory to bounce back and serve the population once more. A breeding ground that is favourable to a greater conscience can of course only be sought at the individual level. But the initiatives observed illustrate that searching for a territorial breeding ground, and so on a more global level, can develop a collective conscience and meaning (Rabourdin, 2012).

[12] I.e. developing strategies and actions specific to the territory, while linking these strategies and actions to the outside. It involves a combination of private persons/individuals and global/collective.

[13] Concept developed by Amartya Sen. Capability is defined as "a set of vectors of functionings, reflecting the person's freedom to lead one type of life or another".

[14] The Transition Handbook, R.Hopkins (2010)

The Roanne Area, on the north-west border of the Rhône-Alpes region, between Auvergne and Burgundy, experienced two successive crises (textile in the 1970s, mechanics industry in the 90s) with economic, social and urban consequences. The strategies developed by the players for helping the area to bounce back combine local potential and national (or European) guidelines. They also combine actions to support the traditional sectors and the mobilisation of new industries as well as resources from the social and solidarity economy. The resources and levers are very closely linked to the territory's industrial heritage. Key points in this evolution are the economic governance implemented, the mobilisation of companies and local anchoring of developments.

Resilience and sustainable development: are they complementary?

Today, resilience is mobilised to respond, according to some, to the fact that sustainable development has not kept its promises, as is also the case for the green economy approach. While the green economy approach focuses on efficiency and output without questioning the economic, social and political model, resilience, on the other hand, leads to the transformation of the model. In particular, it questions the role of society and individuals, and encourages a rebalancing towards autonomy and diversity, while seeking efficiency. Seeking an improvement in the capacity for resilience calls for a systemic territorial approach, making it possible to exceed the only objectives for growth and economic development to which sustainable development and the green economy are reduced as they are implemented in a commercial context.

While the sustainable city is built on the idea of a future that can be controlled, on the durability and reversibility of urban functions, resilience enters into play in the presence of a process that disrupts the operation of a city. Resilience allows for the occurrence of harmful events, whether predictable or not, that must be anticipated in order to confront and adapt to them. Resilience is not a substitute for the implementation of the principles associated with the sustainable city. It mobilises these principles in circumstances involving disruptions.

Resilience is a concept that offers meaning, or even hope, as long as it is mobilised in a relevant way, as not all disruptions need to resort to resilience. The enthusiasm it creates reveals expectations and needs in terms of renewing the ways and means of thinking. There is a risk however that resilience will be watered down in a consensus that is void of meaning, in amongst notions such as governance and civil society, or be reduced to no more than a final argument for acting or not acting. As long as these deviations are avoided, the search for resilience can be a path to leaning towards an ideal of sustainability, and can be helpful in leading us to question the principles of sustainable development through the lens of a different approach.

THE CHEMICAL CORRIDOR, FEYZIN
Photo: SERL, Balloïde, H. Canet

The town of Feyzin, located in the Chemical Valley, south of Lyon, is home to several Seveso high-threshold companies. The town develops communal actions based on a strong political will to allow three apparently contradictory territorial dimensions to coexist: factories, natural spaces, a residential component, and structures its plans through the implementation of an Agenda 21. The issue of industrial risks is incorporated in a global sustainable development approach: improvement in the quality of life, actions in favour of landscapes and biodiversity, creation of informational documents on risks and crisis preparation, the practice of participative democracy taking the form, in particular, of a *residents conference*. These actions are characterised by a capacity for anticipation, innovation, actions, and adaptation, but also by links created between players, which encourage individual and collective resilience.

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THE MANAGEMENT AND ANTICIPATION OF NATURAL DISASTERS IN THE WORLD

by Marie-Noëlle PONS, CNRS-Lorraine University

A large number of disasters take place in the world every year, and are unevenly distributed: a resident of Asia is 30 times more likely to be the victim of a disaster than a resident of Europe or North America. The example of San Francisco, with, in particular, the work on the potable water system, is an excellent illustration of the anticipation of a natural disaster and the way in which it is possible to make a territory resilient.

Katrina (2005), Haiti (2010), Töhoku (2011) and Sandy (2012) are among the latest major natural disasters to affect urban areas in recent years. According to CRED[15], a disaster is a situation or an event, unexpected and in general sudden, that causes significant damage, destruction and human suffering that exceeds local management capacities and which requires external national or international assistance. The table on the following page shows the typology used for natural disasters. Some natural disasters may have a global long-term effect: this is particularly true for major volcanic eruptions (Santorini, Vesuvius and Fuji in 1707, Laki and Asama in 1783, Tambora in 1815 and Krakatoa in 1883 are among the best-documented examples) that cause a global drop in the temperature on Earth over several years. Disasters, whether natural or technological (transport accident, industrial accident), that have occurred since 1900 are logged in a database, EM-DAT[16]. The database only includes the disasters that resulted in more than 10 deaths and more than 100 people affected, and for which a state of emergency was declared and international assistance was mobilised.

VESUVIUS, OVERLOOKING THE CITY OF NAPLES (1 MILLION INHABITANTS) AND ITS METROPOLITAN AREA (ABOUT 4 MILLION INHABITANTS), IS A CONSTANTLY ACTIVE VOLCANO.

Photo: MN Pons

In 2013, the 330 natural disasters that occurred worldwide resulted in 21,610 deaths, 96.5 million people affected and caused 100 billion euros in damage. Four of the five most affected countries are in Asia[17] (figure p.66).

[15] Centre de Recherches sur l'Epidémiologie des Désastres, Université de Louvain-la-Neuve (http://www.cred.be/)

[16] http://www.emdat.be/

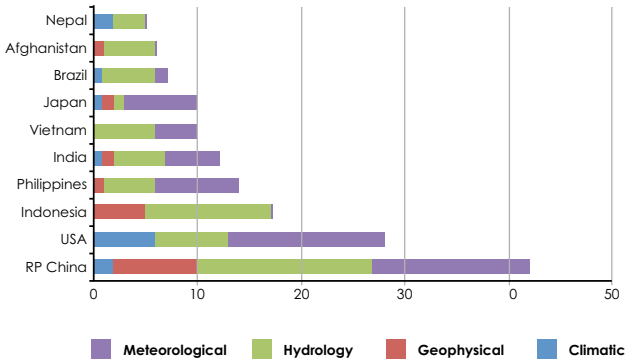
[17] Guha-Sapir D, Hoyois P, Below R (2014) Annual disaster statistical review, the numbers and trends, CRED, Bruxelles

Group	Sub-group		Some examples
Biological	Epidemic	Viral	SARS (2002-2003)
		Bacterial	
		Fungal	
		Parasitic	
		Related to prions	
	Insect invasion		
	Animal stampede		
Geophysical	Earthquake		San Francisco (1906)
	Volcanic eruption		Pompeii and Herculaneum (79) Mount Pelée (1902)
	Gravitational instability (dry)	Rockslide	
		Landslide	
		Avalanche	
		Subsidence	
Hydrology	Flood	High water	Nîmes (1988)
		Flash flood	
		Submersion	Tsunamis (Indonesia, 2004; Japan: 2011)
	Gravitational instability (wet)	Rockslide	
		Landslide	
		Avalanche	
		Subsidence	
Meteorological	Storm	Tropical cyclone	Katrina (2005) Sandy (2012)
		Extratropical cyclone	Lothar and Martin (1999)
		Local storm	
Climatic	Extreme temperatures	Heatwave	Summer 2003
		Cold snap	Winter 2012
		Extreme winter conditions	
	Drought		
	Fire	Forest	
		Plain	

CLASSIFICATION OF NATURAL DISASTERS ACCORDING TO CRED

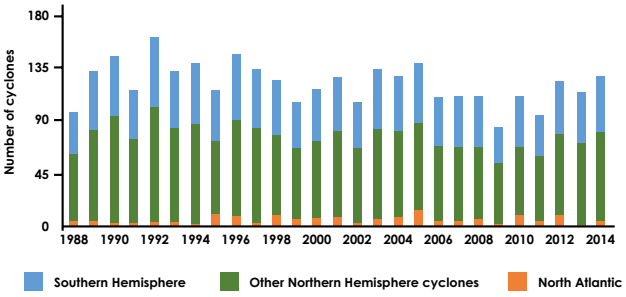
POMPEII WAS BURIED UNDER ABOUT 3 M OF SLAG AND 2 M OF ASH IN AUGUST 79. ONLY ONE PART OF THE TOWN HAS BEEN UNCOVERED TO DATE. THE RESTAURATION OF THIS TESTIMONY TO THE URBANISM OF ANCIENT ROME HAS BEEN CAUSING PLENTY OF PROBLEMS SINCE THE EARLY 2000S, DUE TO THE SEVERE ECONOMIC CRISIS IN ITALY.

Photo: MN Pons



TOP 10 COUNTRIES IN TERMS OF NUMBER OF NATURAL DISASTERS IN 2013

Data: EM-DAT



CHANGE IN THE NUMBER OF CYCLONES IN THE NORTH ATLANTIC AND IN THE WORLD

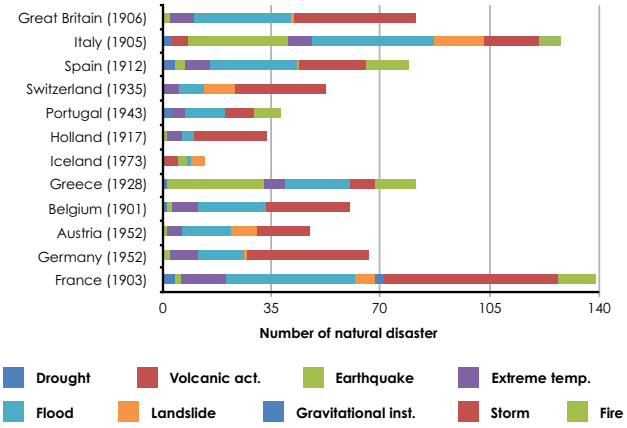
Data: www.cyclonextreme.com

The data for the Northern Hemisphere include data for the North Atlantic, the North-west Pacific, the North-east Pacific and the North Indian Ocean. The data for the Southern Hemisphere include the area between 35° East and 130° West (South-west Indian Ocean and South Pacific).

For the period 2001-2010, Asia is ranked number one in terms of number of events (40%) and victims (90%) and number two in terms of cost (38%), with the Americas in first place for this category (46%).

A large number of inter-governmental entities (UN, WHO, EU) are concerned about the increase in natural disasters since 1980, especially in the Pacific part of Asia. An inhabitant of this area is 30 times more likely to be affected by a natural disaster than a European or North American. Some of these disasters such as earthquakes, and the tsunamis which are often associated with them, and volcanic eruptions are difficult to predict. The issue of the connection between an increase in cyclones and hurricanes due to climate change, driven in particular by global warming, is still causing plenty of controversy. Data on the evolution in the number of these meteorological events do not show a startling change since 1988 (Figure below). Rapid urbanisation increases the risk to which populations are exposed along the subduction zones of oceanic plates.

The following figure compares the natural disaster records in France and in a few other European countries since 1900. While land-based phenomena have caused a large number of disasters in Italy (volcanism and earthquakes), Greece (earthquake) and Iceland (volcanism), storms, floods and extreme temperatures are the most common causes in other countries.



TYPOLOGY OF NATURAL DISASTERS IN FRANCE AND IN CERTAIN EUROPEAN COUNTRIES FOR THE PERIOD 1900-2014. THE DATE IN BRACKETS IS THE EARLIEST NATURAL DISASTER RECORDED IN THE EM-DAT DATABASE FOR EACH COUNTRY.

Source: MN Pons

HERCULANEUM WAS DESTROYED AT THE SAME TIME AS POMPEII. VESUVIUS IN BACKGROUND
Photo: MN Pons

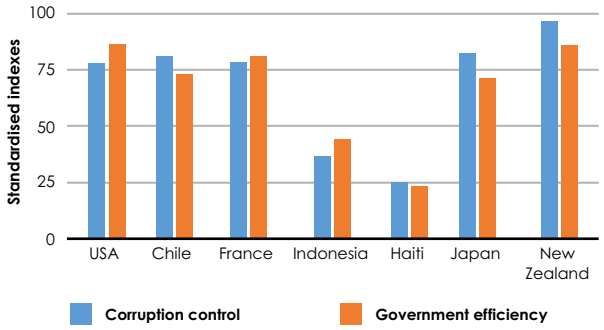
Natural disasters have a significant impact on networks: electricity, water (potable and waste), gas, transport, telecommunications. The electrical network is especially critical as it is required for activating, in particular, the potable water network pumps and the communication system, which is essential for activating alerts in case of a tsunami. During the 8.8-magnitude earthquake and subsequent tsunami that hit central Chile on 27 February 2010, a general power cut occurred while demand was for 4520 MW (i.e. 41% of the total installed power)[18]. 27% of the population of Chile was affected. 6% of the total installed capacity needed repairs while 8.6% was inspected before being restarted. The electrical network, extending over about 2,000 km (about 1,200 miles) from the north to the south of Chile, was back in operation a few hours after the earthquake, even though there was damage to transmission equipment, notably 26% of the substations. However, this power cut resulted in a malfunction in the tsunami alert system, which relies on the Internet and telephone network. Six days after the disaster, global production reached 85% of its level prior to the earthquake. This rapid restoration of service is linked to the quality of the infrastructures (compliance with earthquake-resistance standards) and to the diligence of the employees of Transelec, the company that manages energy transport in Chile. However, it took longer for users to return to normal due to the fact that houses had fallen on the lines, and some houses had been washed away by the tsunami. In the area most affected by the disaster, 80% of customers were still without power the next day, and 0.4% two weeks later.

In the case of the 6.3-magnitude earthquake that shook Christchurch (New Zealand) in February 2011, the electricity supply was restored to 82% of households with five days. 95% of customers had power restored within two weeks of the disaster. As for the potable water supply, 70% was restored within a week.

These events affected developed countries, where the number of victims (185 in New Zealand and about 600 in Chile) is relatively low compared to the disasters of 2004 in Indonesia (235,500 deaths) and 2010 in Haiti (220,000 deaths). According to Kaufman and Tessada[19], a high level of corruption control and a highly efficient government are factors that help keep the number of victims low. However, the 9-magnitude earthquake recorded in Japan in March 2011 and the powerful tsunami that followed (about 16,000 deaths and 4,700 missing) put the issue into perspective.

[18] Rudnick H, Mocarquer S, Andrade E, Vuchetich E, Miquel P (2010) Lessons from the 2010 Chilean earthquake and its impact on electricity supply, Proc. 2010 Int. Conf. on Power System Technology (Powercon 2010) Hangzhou, China

[19] Kaufmann D., Tessada J (2010) Natural disasters, natural diligence: the Chilean earthquake in perspectives. http://www.brookings.edu/research/opinions/2010/03/05, downloaded 24/12/2015



CONTROL OF CORRUPTION AND GOVERNMENT EFFICIENCY
2012 data, World Bank

As the examples of Chile and New Zealand show, planning, compliance with construction standards and exercises are important factors in reducing the number of victims and in returning all the networks to operation. The example of San Francisco, which is waiting for the Big One, shows how it is possible to improve the resilience of a distribution system, in this case, for potable water.

The San Francisco region, home to about 7.5 million people, is crossed by a large number of faults, the most well-known of which is the San Andreas fault. In 1906, a shift of several metres of the Pacific plate along this fault indirectly caused the destruction of the city by a fire that resulted from an 8.2-magnitude earthquake. The United States Geological Survey estimates the likelihood of seeing a 7-magnitude in the next 30 years as 60%. Such an earthquake causes significant widespread damage. Most of San Francisco's potable water supply comes from an artificial lake (Hetch Hetchy Reservoir) located 270 km (about 170 miles) east of the metropolitan area in the Yosemite National Park. Water must be transported over several major faults. A break in the pipes would affect 2.6 million consumers with subsequent risks for public health and safety. Since 2004 the San Francisco Public Works Commission has implemented a US $4.8 billion programme[21] for establishing a water supply system that is resilient to future earthquakes: the 80 worksites include the replacement or repair of dams, reservoirs, pumping stations, tunnels, pipes and processing plants. The global solidity of the system depends on the solidity of its weakest component. The pipes that cross the Hayward fault near the city of Fremont were designed to withstand a shift of almost 2 m by combining sliding auto-compensating joints, ball joints and a tunnel with a flexible vault. Redundancy, i.e. the possibility of one part of the system replacing a defective part, is a key principle for ensuring the system's global resilience. In addition, standardisation was pushed to the limit to allow the ten public works companies involved to successfully complete the various worksites, more or less concurrently and spread over a wide geographic area. The programme will be completed in 2018.

The United Nations office for disaster risk reduction (UNISDR) is working to reduce all these risks and

CRACKS IN A BUILDING DURING THE EARTHQUAKE THAT AFFECTED SAN FRANCISCO ON 17 OCTOBER 1989
Photo: MN Pons

[20] Institut d'études géologiques des Etats-Unis
[21] AECOM, Water 21, October 2014, pp 20-21

to develop a culture of prevention in society, by building a world in which nations and communities will be resilient in the face of natural disasters and climate change, while being able to develop and prosper over the long term. The Hydogo Framework for Action[22], adopted by the UN in 2005[23], meets the requirement for a broad, integrated and multidisciplinary approach to identify and implement risk-reduction measures on a global level. To this end, five priorities for action have been developed:

1. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation
2. Identify, assess and monitor disaster risks and enhance early warning
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels
4. Reduce the underlying risk factors
5. Strengthen disaster preparedness for effective response at all levels

For the period 2007-2013, UNISDR has summarised progress with scores ranging from 3.1 to 3.5 (out of a maximum score of 5) for these various actions[24]. These scores indicate that there is still much work to be done. A large number of programmes, in particular in the areas of training and education, have been put in place, such as, for example, "My City is Getting Ready"[25] in South America and the Northeast Asia and Global Education and Training Institute (ONEA-GETI), in South Korea, targeting professionals.

[22] From the name of the Hyogo prefecture in Japan, the capital of which, Kobe, was severely damaged by an earthquake in 1995

[23] Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters (http://www.preventionweb.net/english/professional/publications/v.php?id=1037&pid:22&pif:3)

[24] UNISDR, Implementation of the Hyogo framework of action, Summary of reports 2007-2013.

[25] Ma ville se prépare

RESILIENCE, A LEVER FOR REVITALISING URBAN TERRITORIES

by Anne CHARREYRON PERCHET, Senior Advisor, Sustainable Cities, General Commission for Sustainable Development, MEDDE (French Ministry for Ecology, Sustainable Development and Energy)

Cities are vulnerable, economically, socially and environmentally. But these vulnerabilities make it possible to develop resilience strategies. Vulnerability and resilience are not contradictory. They are two very different concepts but are often highly energising for the territory. There are plenty of examples showing the capacity of urban systems to implement resilience processes when faced with gradual disruptions or shocks.

Today, territories are faced with far-reaching transformations associated with climate change and the increasing scarcity of resources, with economic mutations and with demographic changes (ageing populations). These mutations make territories more vulnerable and cause them to develop the capacity to adapt in order to absorb disruptions and transform their structures, ensuring long-term operation. With regard to these changes, the concept of urban resilience[26] has emerged as a new tool for the revitalisation of territories.

This article is based on work carried out at the General Commission for Sustainable Development (Commissariat Général au Développement Durable, CGDD) on the resilience of urban territories. Cities are seen as urban systems in which environmental, economic and social vulnerabilities come together and accumulate. It was therefore decided to go beyond the traditional dimension of managing natural risks to expand the issue to all risks or mutations that affect a territory and to focus on the resilience strategies implemented at the local level.

The vulnerability and resilience of territories

While certain territories are more vulnerable than others due to their geographic location, their topography, or their industrial past, they are all affected to varying degrees by climate change. The 2003 heatwave that caused 30,000 deaths in European cities (including 15,000 in France) showed the disastrous effects of long-term heatwaves in urban environments accompanied by atmospheric pollution and a significant water deficit. Storms such as Xynthia and floods that regularly affect certain regions are a testament to worsening impacts due to climatic fluctuations. This worsening is itself a result of the increasing pressure that cities place on the environments and on the means of urbanisation marked by urban sprawl and land take. This physical vulnerability of urban territories is supplemented by social vulnerability. As demonstrated by Katrina in New Orleans, floods are most devastating for people who live in buildings located in flood zones often because they lack the resources to move elsewhere.

[26] Resilience can be defined as the capacity of a system to find a new state of balance after a disruption, sometimes the same state as before the issue (following an abrupt shock), sometimes a new state resulting from its capacity to renew itself, reorganise itself, and find new trajectories to be better armed against new mutations or disasters.

CONSEQUENCES OF HURRICANE KATRINA IN NEW ORLEANS
Photo: News Muse

In addition to the abrupt shocks associated with natural or technological disasters, other forms of vulnerability are associated with situations of gradual economic, social and environmental deterioration. Small and medium-sized towns are particularly sensitive to these vulnerabilities. The devitalization processes can be driven by various factors that are mutually reinforcing: closure of industries that have a long history in the territories, companies weakened by their situations outside of trade flows, limited appeal for active populations, ageing of the population, etc. This is typical of the case for the coal field in the Nord Pas-de-Calais region where the decline in mining activity since the 60s has had harmful consequences on the economy and on society with a significant increase in unemployment and impoverishment of the population, but also on the environment with pollution of the groundwater from mining residue and land pollution after the departure of the mining companies.

However, in the face of vulnerabilities that are increasingly complex, according to M. Lussault[27] the challenge is not so much to control or eliminate them but rather to consider them as elements for the revitalization of the societal system. "*It is because they are vulnerable that urban systems will be dynamic. It is because they are faced with weaknesses that systems evolve, develop, create new skills, new know-how, new instruments... Vulnerability is our future and our fuel.*" Vulnerability and resilience are not contradictory. They are two concepts that overlap. To follow M. Lussault's reasoning, it is because we are vulnerable that we can be resilient.

Which levers for implementing resilience strategies?

[27] M. Lussault, La vulnérabilité urbaine, notre horizon ? http://babel.hypothèses.org/22

The case studies that we have carried out in France and abroad[28] show the diversity of the mechanisms that can be mobilised for implementing a resilience process. There is no single model for resilience, and resilience can appear in a very wide range of forms and types depending on local contexts. However, it can be seen that whatever the factors contributing to vulnerability, certain factors stand out.

- **The development of the territory's resources (natural resources, heritage resources, know-how, etc.)**

After identifying a territory's potential, local players have implemented strategies that have made it possible to incorporate resilience into the development of the territory. This is what happened at the Le Mené community of municipalities in Brittany, a region traditionally focused on livestock and agriculture and which, faced with a risk of land take, implemented a strategy based on the development of local resources to produce renewable energies: construction of a methanation unit using waste from livestock, construction of an oilseed plant for processing locally grown soy into agrofuel for tractors and producing soybean meal as animal fodder, construction of a wind farm, etc. The challenge might also be to turn a threat or a constraint into an opportunity as was the case in Altena, Germany [29] where the Lenne River (a tributary of the Ruhr and sub-tributary of the Rhine), seen as a threat following many floods, was redeveloped to become an urban amenity that added to the town's appeal.

The mobilisation of local resources can also become the means to rebuild local identity. In Lodz, Poland, the rehabilitation of the town's cultural heritage based on cinema made it possible to simultaneously rebuild a positive external image and to create a feeling of pride for the local populations by remobilising the history of the area not based on economic failures but on its cultural and architectural wealth.

- **The mobilisation of local assets**

The ability to rely on the existing solidarity networks and the support for the initiatives driven by local players are decisive in implementing resilience strategies. This is evident in the case of the Le Mené community of municipalities mentioned above, where the tradition of agricultural unionism and experience with cooperatives made it easier to implement local projects associated with energy transition. The strengthening of local skills is also at the heart of the strategy carried out in the prefecture of Kyoto with the creation of partnerships between local universities and the local authorities to identify and implement local development projects. On the other hand, the failure of El Bierzo where the Spanish government unexpectedly "imported" a foundation in the field of energy shows the importance of insertion in the local economic and social fabric. For the cities or territories that are beginning to emerge from a latent or abrupt crisis, it appears essential that the relaunch operations be based on the territory's "capabilities[30]" or capacity to act, resulting from the local capacity for responsiveness and the mobilisation of the primary players but also of the territory's potential.

- **The implementation of integrated strategies**

Implementation occurs on two levels:

- On the one hand, through synergies created between local players. This is the case between university environments and local authorities in the example of the prefecture of Kyoto, it is also the case at Feyzin where the refinery accident in 1966 led to the creation a few years later of a *Residents Conference*, a forum for dialogue between residents and industry.
- On the other hand, in the very content of the strategy to be implemented. The work carried out at the CGDD on "Integrated analysis of territorial resilience"[31] shows that for natural risks, the challenge is to reconstruct a local project that

[28] For international case studies, see Etudes et documents n° 117 (Studies and documents no. 117) (CGDD publication, downloadable at http://www.developpement-durable.gouv.fr/Villes-resilientes-etudes-de-cas.html). Report on French case studies published in the first half of 2015

[29] Schlappa Hans: "Shrinking cities : challenges for policy and practice", The URBACT Tribune, November 2012

[30] The term "capability" is taken from the work of Indian economist Amartya Sen, winner of the Nobel Prize for Economics in 1998

combines actions in terms of land occupancy, resource management, risk prevention, local economic development and social accessibility. In another area the actions implemented at Loos-en-Gohelle, in the Nord Pas-de-Calais region, are part of a local momentum that combines the preservation of resources, innovation, rehabilitation of industrial heritage, tourism, and more.

- **Combining the scales of time and space**

In terms of space, in many cases there is a clear "overlapping" of the actions carried out at various levels. Here too, Pas-de-Calais is fairly representative with projects driven at the national level (the Louvre Lens) as well as the regional level (Regional Planning and Sustainable Development Scheme 2040), at the level of the institution in charge of the conversion of the Coal Field and finally at the municipal level. In the Roanne area, the identification of the five sectors for local redevelopment is based on the potential of the area but also on national and European priorities in terms of industrial policy, in order to secure public financing.

In parallel to the space dimension, the time dimension is a significant factor in resilience strategies. This involves both combining short-term actions with long-term actions but most importantly, getting local players involved in anticipatory surveillance. This is what was done at Feyzin where ecological transition has led local players to ponder the issue of what comes after the refinery and how the town will be integrated in the future Chemical Valley, a key project for the Lyon metropolitan area. A forward-looking approach is also at the centre of the work implemented by the Nord Pas-de-Calais region in the Vision 2040 project, a major participative construction strategy for a future project in the territory based on a positive view of resilience.

Today, resilience is a necessary element of ecological transition. By reactivating local momentum, by getting all relevant players involved and by demonstrating anticipation, resilience strategies can get the territories heading in the right direction once again. It is still true though that the role of politics is decisive in setting up such strategies, with elected officials having primary responsibility in the ability of citizens to plan their own future rather than having it imposed upon them.

LOOS EN GOHELLE
Photo: Jérémy Jännick

[31] The case studies have been grouped together in the resilience wiki http://wikiresilience.developpement-durable.gouv.fr/index.php/Accueil

THE SAFETY OF DRINKING WATER SYSTEMS: IMPROVE RESILIENCE BY BETTER UNDERSTANDING VULNERABILITY

by Caty WEREY, Irstea UMR GESTE Strasbourg, Olivier PILLER, Irstea UR ETBX Bordeaux, Bénédicte RULLEAU, CEARC, UVSQ, Guyancourt and Irstea UR ETBX Bordeau, Jean-Bernard BARDIAUX, ENGEES UMR ICUBE Strasbourg

For work involving potable water networks, it seems important to properly understand their vulnerability and in particular by distinguishing structural vulnerability (impact on assets, network infrastructures), operational vulnerability (impact on the service provided to users) and external vulnerability (impact beyond the water service itself, on the environment or the mechanical activities).

The potable water networks, the primary infrastructures of the public potable water service that aims to supply enough potable water of adequate quality through a service that meets the principles of equality, continuity and mutability, are infrastructures that attract the close attention of the local authorities by which they are managed. The primary goal is to avoid disruptions to service.

These disruptions can be, on the one hand, linked to the normal operation of the service (water quality issue resulting from work carried out, pipe break, etc.) and, on the other hand, to one-time events, associated with natural risks (earthquakes, floods causing erosion or a break in the network, etc.) or to intentional malicious acts (contamination, explosion, etc.).

In the first case, the work required due to these disruptions includes purging and one-time repairs, sometimes carried out in connection with a renovation programme to be implemented as part of a asset management initiative. In the second case, the disruptions will be more severe. As they are not restricted to one pipe or one neighbourhood, they could destabilise the operation of the entire system, either directly or through a domino effect (particularly in connection with an interruption to the energy supply). The structural integrity of the network can therefore be impaired, as well as the organisational integrity of the service that operates the network.

The analysis of events such as these is done by introducing the concept of risk with the goal of understanding the phenomenon and assessing the damage. In addition to the disaster experienced, it is the capacity to react to the hazard, driven by the concept of the system's resilience, that must be studied and defined.

The notion of **risk** is multiple and can be understood as the intersection of three aspects: the hazard, the vulnerability and the damage or impacts. Here, we are interested more specifically in the concept of vulnerability and resilience, for defining the outline of these concepts and giving examples of applications on the urban networks and in particular the potable water networks.

The concept of **vulnerability** has been addressed by plenty of authors. Here we will use the definition given by J.-F. Gleyzee and M. Reghezza (2007) which can be divided into two sections: "structural" vulnerability which involves the physical infrastructure and "operational" vulnerability that refers to the disruption in the organisation of the services provided to users. Thus, this definition separates the "support network" from the "service network". The authors also highlight the fact that damage from the first category is relatively easy to assess, which is not the case for the second (e.g., calculation of lost time).

But the notion of vulnerability can also make it possible to characterise the externalities, i.e. the impacts on the agents or elements outside of the service in question. In this case we use the term "external" vulnerability.

Finally, another approach involves social vulnerability (Becerra, 2012, Hellequin et al., 2013) by taking into

account the perceptions of the various users of the infrastructure or of the natural environment.

As for the potable water networks and the distribution service, a detailed analysis of vulnerability makes it possible to better define the various impacts in the case of a malfunction in the network and in the service provided. In this way, structural vulnerability will consider the instability of the soil, operational vulnerability will consider the impacts on consumers (characterisation of consumers affected by water service interruptions, by water quality, etc.), external vulnerability considers the impacts of the malfunctions on the socio-economic environment (more difficult or impossible to access shops, road detours if there is pipe break, etc.) or on the natural environment (pollution of the host environment if there is a purge of the network, etc.). External vulnerability can draw on the social vulnerability approach to make the connection with the perception of users.

Various national and international projects have already covered these issues. The study of vulnerability in the case of deliberate contamination of the potable water networks is being finalised as part of the French/German ANR project SMaRT-Online^{WDN}[32] (Piller *et al.*, 2015 a and b, SMaRT-Online^{WDN} 2015). To define the damage, the risk analysis, put forward in this work, describes the notion of vulnerability of the structure as the notion of "the network's intrinsic vulnerability to contaminant intrusion", the structural effect in this case being less important, and operational vulnerability as the consumer's "sensitivity" to the malfunctions - for example in terms of health if contaminated water is ingested or of loss of economic activity if water is used in the manufacturing process.

In the context of asset management of the potable and waste water networks, operational and external vulnerabilities have been analysed in the European projects CARE-W[33] (2000-2003) and CARE-S[34] (2003-2005) and in the ANR project INDIGAU[35] (2008-2010) (Werey et al., 2012) to define the impacts of the malfunctions or of the network rehabilitation work on the socio-economic environment (users of the services, as well as road users, retailers, etc.) and on the natural environment.

As for the notion of **resilience**, it covers various operational and conceptual stages: crisis management at the time the event occurs, the prevention and anticipation capacity, to allow the system/service to quickly return to its acceptable state, i.e. operation under the same operating conditions or under new rules, but making it possible to provide a service that is at least equal to the service provided before the disruption.

Several definitions exist, we will be using two. In their study on technical networks threatened by floods, Lhomme *et al.* (2010) define resilience as "the capacity of a system to absorb a disruption and to recover following a disruption", distinguishing "corrective" resilience *i.e.* following a disruption, from "proactive" resilience which makes the connection with the notions of learning and adaptability. On the other hand, Wardekker *et al.* (2010) suggest making the concept of resilience operational via three characteristics:

- the amount of change that the system is able to withstand while maintaining its capacity to control the structural and functional aspects
- the degree of self-reorganisation that the system is able to provide to adapt to external changes
- the capacity to build and increase learning and adaptation ability

On the topic of potable water networks, the launch of a new French/German ANR project, ResiWater[36] (2015-2018), will make it possible to define the various notions of vulnerabilities. For its part, the notion of resilience will be examined in greater depth, but also in defining the curative or proactive operations to be implemented on the potable water network. This analysis will be applied to resolving the three specific case studies defined by the end users of the project, the first on the failure of the distribution system following a natural disaster, the second by a domino effect following a failure caused by critical related infrastructures, and the third for the deterioration in water quality.

This quick overview of potable water networks

[32] SMaRT-Online^{WDN} « Online Security Management and Reliability Tool it for Water Distribution Networks »

[33] CARE W "Computer aided rehabilitation of water networks"

[34] CARE S "Computer aided rehabilitation of sewer networks"

[35] INDIGAU « Indicateurs de performance pour la gestion patrimoniale des réseaux d'assainissement urbains » ("Performance indicators for the asset management of municipal sanitation networks")

[36] ResiWater "Innovative Secure Sensor networks and Model-based Assessment Tools for increased Resilience of water infrastructures"

addressed the notions of vulnerability and resilience which are closely associated with the notions of liability and damages. These notions have been the topic of research projects at Irstea and ENGEES and have inspired discussion within the management services, whether in connection with natural risks or with the fear of intentional acts. It seems to us that defining the vulnerability of a system, under the three aspects, "structural" (for each infrastructure element), "operational" (vulnerability of users or consumers) and finally "external" (externalities), could be combined with the knowledge of hazard simulation in order to plan how to best react. The notion of criticality which makes it possible to measure the system's performance must be expanded to cover the various hazards. The notion of resilience is complementary and makes it possible to prepare water services to better plan their responses. On the other hand, on a more operational level, the safety of the network, in the case of extreme events, goes beyond securing the potable water supply, by connecting to the neighbouring network to ensure continuity of service. The scope of the damage and the number of players involved in the "reaction" process, etc., mean it is necessary to develop new approaches and to look, on the one hand, at the potable water management system - from the resource to the infrastructure to the consumers to the natural environment - and on the other hand at the interaction in terms of risks and domino effect of all the networks and municipal services with the users and the natural environment if a rare event should occur.

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RESILIENCE AS A NEW RISK-MANAGEMENT STRATEGY. THE PARISIAN METROPOLIS VERSUS A LARGE FLOOD[37]

by Magali REGHEZZA-ZITT, École normale supérieure

The consequential damage for a flood such as the one that hit the Paris region in 1910 would today be 30 times higher (€30 billion) than in 1910. Mostly because the area below ground is used and occupied much more than it was in the early 20th century. But the consequences would be much more widespread due to the specific character of the capital city, with a potential drop of 3% in France's GDP.

The Paris metropolitan area is exposed to the threat of exceptional flooding of the Seine and its tributaries. Such an event is likely to cause flooding not only at ground level but also below ground. These floods have a significant destruction potential since a 2014 OECD report[38] indicates a cost of 30 billion euros with a drop in GDP that could be as high as 3% (i.e. almost 59 billion euros).

While these floods have an extremely high direct tangible impact, they also cause major operational disruptions, the effects of which will be felt well beyond the flooded area. Most of the technical networks, which provide strategic services for daily life and economic activities, are severely threatened, as they are located below ground: public transport, energy, potable water, heating, telecommunication will suffer severe disruption, so much so that the entire metropolitan area is likely to come to a standstill. Moreover, the status of the Paris region sets it apart from the rest of the country, creating specific vulnerabilities. As the capital, Paris is home to the executive and legislative branches of governance, leading government departments and embassies. Its historical, artistic and architectural heritage is exceptional, making it one of the world's most popular tourist destinations. It has also become a metropolis of global importance. The city attracts intellectual activities such as research, development, fashion, art and all the country's media. It is an international logistic hub. As a global city, Paris is the location for strategic economic and financial decision-making operations that are international in scope. In short, an exceptional yet localised flood would have consequences for the entire country, even for Europe and the rest of the word.

Finally, the flood risk in Île-de-France is atypical: the threat is different from that which hit the capital in 1910, the date of the most recent major flood. The flood of 1910, which, incidentally, serves as a reference (so-called 100-year flood), caused physical damage that was extensive but much lower (30 times lower) than the damage that we would expect today if a similar event were to occur. Above all, the consequences of operational disruptions would be unprecedented, with effects that linger over time and space, making management mechanisms partially inoperable.

[37] This text summarises the article "Resilience as a new risk-management strategy. The Parisian metropolis versus a large flood" published in 2012 in "Urban Resilience". Cities faced with disasters, under the guidance of Magali Reghezza-Zitt and Géraldine Djament-Tran, published by Éditions Le mansucrit.

[38] OECD, OECD study on the risk of the Seine flooding in Ile-de-France, 2014, 214 p.

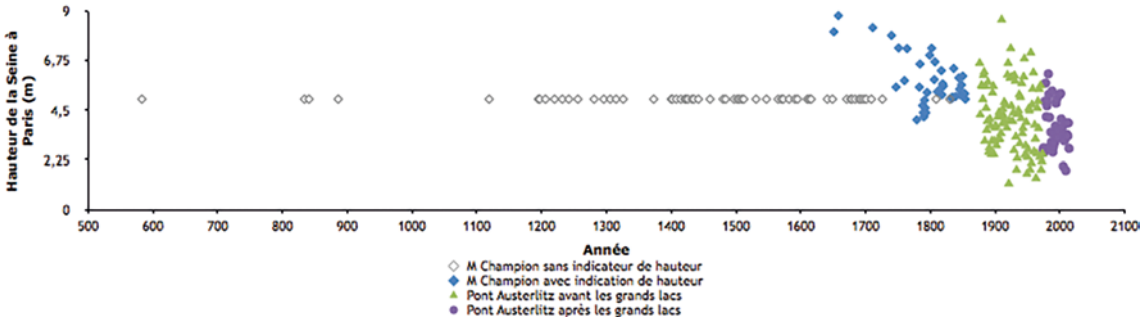
FLOODS IN PARIS ON 28 JANUARY 1910. COUR DE ROME AND PLACE GABRIEL PÉRI, SAINT-LAZARE STATION

Photo: Bibliothèque nationale de France [French national library], Prints and Photography department, EST EI-13 (65)

Due to the kinematics of flooding, as well as to the variety of elements exposed, directly and indirectly, and the domino effects associated with the technical networks and the interdependence between the various areas of the city, the way the crisis unfolds is largely impossible to predict, leaving managers in a situation of structural uncertainty. At best, they can draw up a certain number of indicative scenarios, while knowing that whatever happens, they will be forced to take many decisions on the spot. In particular, it is necessary to anticipate the organisation of preventive measures without any assurance that the event is indeed an exceptional flood.

In these circumstances, traditional management measures are both absolutely essential and completely insufficient. It is, in fact, impossible to prevent the flood from occurring. It is however possible to significantly reduce the scope of the flood, thanks to engineering measures (levees, protection walls, and, in particular, retention dams). But in addition to the fact that these infrastructures give residents a false sense of security, they cannot prevent the flood. Likewise, the regulatory provisions that govern urbanisation (Risk Prevention Plan) are useful, but often turn out to be unsuitable for regions that are already largely built up, undergoing urban renewal or where demand for land is high. Finally, preventive information faces many obstacles, whether it is a question of companies or populations.

Since the late 1990s, public authorities have become aware of the unavoidable and unprecedented nature of the future crisis. Public authorities, and more specifically the Police prefecture, have therefore put in place a resilience strategy, although it is not clearly identified as such. The idea is that while the Parisian metropolis is a remarkably vulnerable area, it could compensate for this vulnerability by an increased capacity to respond to the flood, to overcome disorganisation, to minimise physical damage and disruptions so that the territories can rapidly return, if not to normal, at least to a satisfactory state of operation. The zonal flood emergency plan (plan de secours inondation zonal, PSSIZ) drawn up since 2001, which was then incorporated into the ORSEC (Organisation de la réponse de sécurité civile, Civil Security Response Organisation) mechanism is a pragmatic response to a new situation. It calls for a radical change in the culture of risk. A desire for "zero risk" and "zero damage" is replaced by a culture of a known and accepted risk, where each person will have to respond to the crisis individually to minimise the negative impacts. Here it is indeed the ability



HISTORY OF SEINE FLOODING BASED ON DATA FROM M. CHAMPION* (UP TO 1854) AND FROM GOVERNMENT DEPARTMENTS SINCE 1876. OUR THANKS TO M. VALENTE AND P. BATTAGLIA FOR THEIR HELP IN GATHERING THE DATA.
FLOODS IN FRANCE SINCE THE 6TH CENTURY TO TODAY, RESEARCH AND DOCUMENTS CONTAINING CONTEMPORARY ACCOUNTS, GOVERNMENT DEEDS, OFFICIAL DOCUMENTS, ETC. OVER THE AGES, WITH HISTORICAL DETAILS ON THE DOCKS, BRIDGES, LEVEES, ROADWAYS, EMBANKMENTS, ETC., PUBLISHED, ANNOTATED AND PUT IN ORDER BY MR MAURICE CHAMPION, V. DALMONT, PARIS, 6 VOLUMES, 1858-1864. CDROM, EDITION QUAE

to bounce back that is in the spotlight: the crisis is accepted, but it is not suffered. It is not a question of a fatalistic attitude but rather, a different approach, with the idea that the crisis does not unavoidably produce a disaster. We can however add a word of caution. For now, reconstruction in the strict sense of the word is not, or is barely, taken into account.

In this context, all the areas of preventive management that we have mentioned would benefit from being included in a global mechanism that would no longer separate risk/crisis but where anticipation and forecasting would be in place at all stages of management (before, during and after the crisis).

LAKE DER-CHANTECOQ, WITH A SURFACE AREA OF 48 KM², WAS CREATED TO PROTECT PARIS FROM FLOODING OF THE SEINE. OVER THE YEARS, IT HAS BECOME A POPULAR TOURIST DESTINATION, IN PARTICULAR FOR ITS ORNITHOLOGICAL INTEREST, NOTABLY THE COMMON CRANES WHICH VISIT IN NOVEMBER.

Photo: MN Pons

THE RESILIENCE CONDITIONS OF PARIS AREA MUNICIPAL SERVICES FACED WITH A MAJOR FLOOD

by Marie TOUBIN, Egis

Municipal services are highly interdependent. Workshops based on the scenario of a major flood in the Paris area have shown the collaboration required between the various municipal services. But they have also identified the troubled strategies of certain services, due to inadequate anticipation of the reduced operation of other services. Therefore collaboration strategies appear to be essential as part of the resilience of urban territories.

Cities, municipal services and risks, a complex system that requires collaboration between the city's players

Resilience, an operational response to understanding this system?

In industrialised and urban societies, municipal services are major witnesses to the disruptions experienced by cities and the population's high degree of dependence (Blancher, 1998). Therefore municipal services are an important factor in the appeal of cities, but the continuity of network services remains a major challenge, in particular due to the fact that their interdependence is underestimated (Robert and Morabito, 2009). With a view to improving cities' capacity to respond to a disruption, drawing attention to municipal services makes it possible to support all other urban operations, and to develop a driver of action for local authorities. Thus, the complexity of municipal services, in their internal operation, in their degrees of interdependence, in their interactions with the urban territory and risks, can be understood by the concept of resilience.

Based on the notion of a system able to absorb a disruption and still maintain itself (Holling, 1973), the concept of resilience has expanded considerably to many other disciplines. Based on characteristics often attributed to a resilient system: absorption, adaptation, learning, damage limitation and re-establishment, the objective is to define not the resilient city but the conditions of its resilience. If urban resilience is "the capacity of a system to absorb a disruption and to recover following a disruption" (Lhomme *et al.*, 2010), the networks supporting the urban operations are an essential prerequisite to a city's resilience. But this assumption does not always make it possible to operationalise the concept so that the local authorities and local players can understand it.

The benefit of collaborative approaches

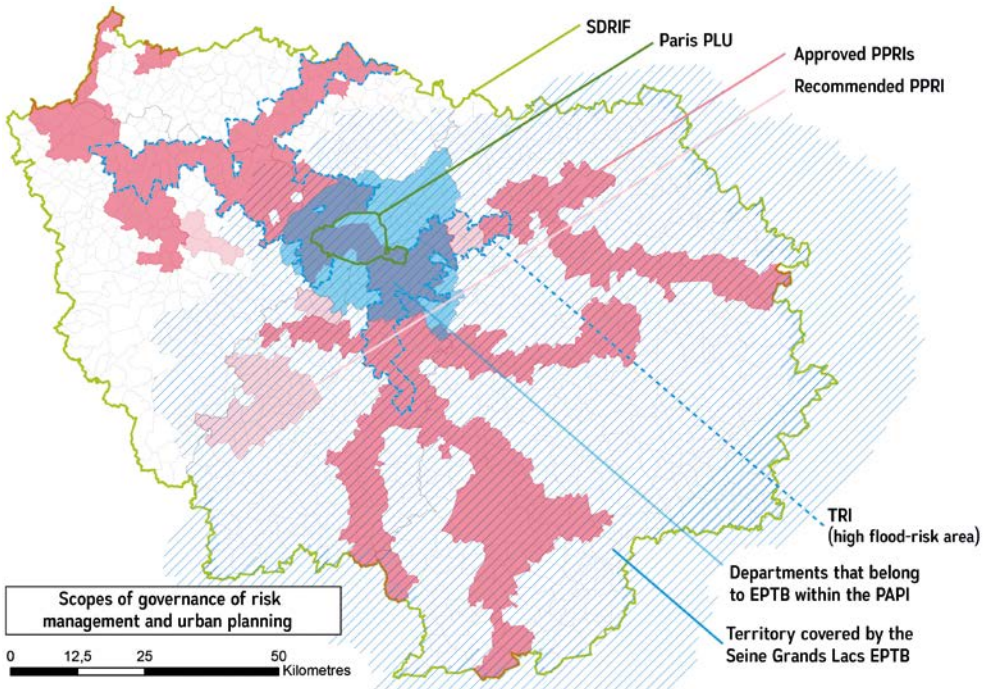
The challenges associated with improving resilience cover a large number of difficulties which have led to the emergence of collaborative approaches in the area of the environment. When decisions can no longer be made on the basis of reliable and comprehensive expert reports, new sources of knowledge must be found (Callon et al., 2001). In addition to the increase in knowledge fostered by collaborative approaches, learning and commitment on the part of the participants have been shown in plenty of experiments.

Mobilising operational players for research purposes must also make it possible to meet their needs: therefore it does indeed involve action research (O'Brien, 2001). To test the strategy for identifying and managing interdependences and validating the hypothesis relating to the importance of collaboration, the city of Paris was chosen due to its risk factors, governance and specific urban operation.

A trial strategy for the collaborative identification of interdependences in Paris

Introduction to the context in Paris

The city of Paris faces a major risk of flooding from the Seine, but the most recent event dates back to 1910. The estimated damage caused by a similar event today has skyrocketed and the indirect impacts of the many disruptions to municipal services are difficult to anticipate. Therefore, improving the resilience of municipal services in Paris to a flood similar to that of 1910 is a challenge for the authorities. A large number of players have examined the various issues involved in reducing this risk: in terms of the hazard, the challenges and crisis management. Thus, the scales of governance, the temporal scales of the actions, the spatial scales of activity collide (figure below), with sometimes contradictory effects. The existing tools and regulations form a structure that is too fragmented to efficiently manage the complexity of the flood risk in Île-de-France (OECD, 2014).

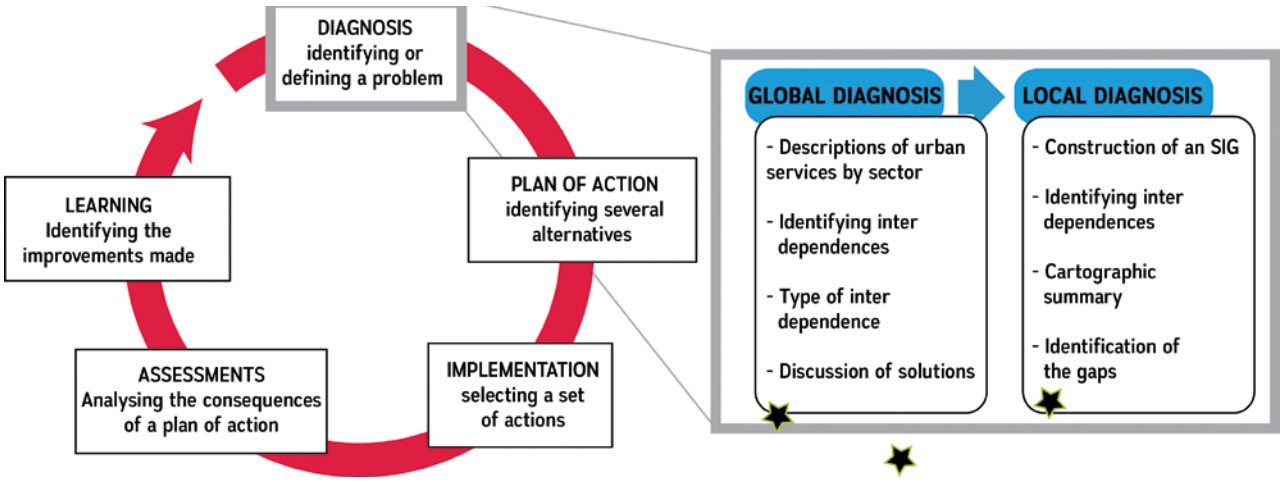


VARIOUS SCALES OF RISK MANAGEMENT AND URBAN PLANNING

The data for PPRIs (plans for flood risk prevention) are dated 1st January 2013, source: DRIEE (Direction régionale et interdépartementale de l'environnement et de l'énergie, Regional and Interdepartmental Division for Energy and the Environment)

In terms of municipal services as well, the operators, organisers and delegating local authorities are numerous. The tremendous variety of municipal services in Paris, which contribute to the city's efficiency and appeal, then becomes a handicap if there is a disruption. The various responsibilities, ranging from short term (operation) to long term (planning), from the local level (operational site) to the global level (national or international company) become intertwined and make decision making more complex. And yet, the interdependences of these levels and the various municipal services are critical for the continuity of activity in the case of a flood. Therefore it seems important to identify and formalise these interdependences with the support of the stakeholders, in order to increase their knowledge of the subject and establish the bases for integrated management of municipal services.

This is a new way of thinking about the city, both in terms of its relationship to the risk and in terms of daily management. Thus, for the players to successfully take ownership of this change, they must be involved in the analysis and definition of this new approach. Regarding the interdependences, first and foremost the issue should be more clearly defined by specifying a methodology for identifying and analysing the dependences of municipal services. The managers of Parisian urban services have the support of the City of Paris for carrying out an initial overview, by system, of the dependences of each municipal service. This initial global analysis of the systems already provides an opportunity to collaborate on the problems encountered and the solutions chosen by the managers. Next, a more in-depth analysis is carried out on a more local level to identify the role of the interdependences in the strategies put in place by the managers and in the territory's resilience.



A DIAGNOSIS ON TWO LEVELS FOR THE FIRST STEP OF AN ACTION RESEARCH
Adapted from O'Brien, 2001

Diagnostic methodology for the interdependences

The systemic approach to municipal services, based on an input-output description of the resources required for these services to operate, makes it possible to analysis the system on various levels, depending on the degree of accuracy given by the manager being questioned (Robert et al., 2009). For this, the self-diagnosis checklist is used to assess several characteristics: user autonomy, supplier reliability, impact on the operation of the service (damage, qualitative or quantitative deterioration in the service), outgoing resources (services provided, indirect outputs and effects), etc. The manager must also assess his or her own ability to provide the service (reliability, time taken to restore service), and in particular, identify his or her users and their dependence.

Distinguishing between technical dependence (resource or service directly required for the process) and organisational dependence (resource or service required for optimising the process or organising the service) then makes it possible to refine the analysis of the interdependences. Once the characteristics of the difficulties have been identified, the second workshop aims to discuss the various solutions put in place by the managers. This global analysis of the interdependences and solutions is not, however, sufficient for assessing the capacity of system to provide its service: geographic and technical disparities must be taken into account. To do this, it is necessary to go down one level in the description of the systems and identify the critical components.

A spatial tool for identifying and managing interdependences

Building a database and a flood scenario

Access to the quantified and spatial data of municipal services is a major challenge in works that seek precisely to assess the resilience of a territory (Robert and Hémond, 2012). To limit the collection of data that are not readily distributed by managers, an approach based on the critical points of each network, and not on structural analysis, is preferred. The description of the flood scenario impacting south-east Paris thus makes it possible to identify potential incompatibilities (in time and space) between the strategies of each manager. This method results in a day-by-day summary of the actions and impacts over all services in the territory, which constitutes major progress in understanding flooding in Paris. All analyses produced using the SIG (Système d'information géographique, Geographic Information System) by topic or by day, were presented to the managers during the most recent collaborative workshop. In this way, they were able to assess the sometimes poorly anticipated constraints hindering their crisis management plan. The SIG tool makes it possible to identify the weak points that require a verification of the measures taken or a more in-depth assessment of the service provided by the networks.

Contributions from collaboration and analysis of resilience

Collaboration has been proven essential by the managers who participated in the workshops. Creating a network of managers is a first step that could become a forum for strategic decisions aimed at global resilience, and for bilateral cooperation to address local issues. To achieve this, sharing knowledge and the subsequent collective learning improve the managers' flexibility and facilitate the integrated management of service by the organising local authority.

This research makes it possible to assess the conditions of Paris' resilience on the various scales of time and space. The impacts on the entire city are difficult to map precisely but it is possible to identity the main principles: a flood zone deprived of all services and which is hard to access, a zone bordering the flood zone that suffers from the loss of one or more vital services (electricity, gas, municipal heating) and the entire territory suffering from inferior living conditions, due primarily to travel disruptions. The results also show the repercussions of equipment malfunction due to local interdependences in the zone studied, over a much larger territory.

Conclusion

The objective of this research was to contribute to the improvement in urban resilience conditions. The analysis of the operation of municipal services in the city, in the face of the risks, shows the importance of the networks in maintaining municipal operations, including during and after a disruption. In addition, the action-research approach initiated with the managers of Parisian municipal services highlights the difficulty of managing interdependences for managers who have established strategies that are too isolated. It also makes it possible to assess the resilience of the municipal services depending on the various capacities for resilience. In particular, it has been shown that resilience strategies are based on different visions and indicators depending on the services. This creates incompatibilities. Collaboration driven by this network of players shows that it is possible to overcome these isolated approaches. Implementing a resilience strategy requires however a change in the global approach to risk, involving acceptance and acknowledgement of defects from the design phase, control of the threshold effects and maintenance of flexibility.

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PRINCIPLES OF INHERENT SAFETY
APPLIED TO CITIES AND TERRITORIES

by Olivier DUFAUD, Lorraine University, Laboratoire Réactions et Génie des Procédés (Laboratory for Reactions and Process Engineering, LRGP)

The four principles of inherent safety (minimisation, substitution, simplification, moderation) are described and illustrated in many examples. Particularly in the area of sanitation services, these principles seem to be applied naturally, and this application could probably be extended to the activities of cities and territories.

While major occupational risks have long been associated with corporate life, these issues have not always been part of the operation of cities and local authorities. Thus, in 2013, almost two-thirds of local authorities in France had not yet set up a transverse and global approach to identifying and assessing risks (Arengi, 2014). However, elected officials and territorial administrators are directly involved in risk assessment and management activities and they can be held responsible if they fail to meet these obligations. In this regard, Articles L. 121 and L. 123 of the French Urban Planning Code are clear. They specify that territorial coherence plans (schémas de cohérence territoriale, SCoT), local urban planning schemes (plans locaux d'urbanisme, PLU) and municipal maps must in particular include the notions of preventing natural and technological risks, pollution and nuisances. These players need to be made aware and, although it is recent, this awareness is now notable because in 2014 more than half of local authorities drew up a map of the risks in their territory and more than 40% of them had a department dedicated to risk management (Arengi, 2014). Incorporating the objectives of sustainable development and safety as early as the design phase of projects is the very essence of inherent safety as developed by Kletz in 1978 after the Flixborough disaster (Kletz, 1978; 1998). After a few definitions of terms linked to risk management, the principles of inherent safety will be laid out and applied to cities and territories through examples.

THE FOUR PRINCIPLES OF INHERENT SAFETY
Photo: Olivier Dufaud

Any global risk analysis approach must allow for the exhaustive and systematic identification of sources of *hazards*, the assessment of the corresponding *risks* both in terms of *likelihood* of occurrence, *intensity* and in terms of *severity* of the consequences, and make it possible to produce a list of actions aimed at reducing risks considered to be unacceptable on a predefined acceptability level (MEEDDM, 2010). Each term used has a specific meaning which, when understood, makes it easier to manage risks. Thus, a *hazard* is an intrinsic property of a chemical agent, an object, a process or a situation likely to have harmful effects on human health, the environment or the system studied (e.g., electricity). As for *risk*, this is the combination of the *likelihood* of an event occurring and the *severity* of the event's consequences on a vulnerable target (e.g., electrocution or electric shock). Distinguishing *hazard* and *risk* means it is possible to tend towards

completeness in the assessment phase, which is difficult to achieve by simply identifying the risks based on feedback from experience. For example, in the case of sanitation networks, identifying gases caused by the decomposition of organic matter (hydrogen sulphide, methane, etc.) as being hazardous substances makes it possible to specify the risks of anoxia, toxicity and explosion. Ultimately, the quantitative risk assessment is carried out using three criteria: the *likelihood* of undesirable events occurring, the *intensity* of their effects, which makes it possible to define the *severity* of their consequences, taking the vulnerability of the targets into account. In the previous example, the intensity of a toxic effect can be quantified in ppm while its severity will be defined by the number of victims affected and their associated degree of poisoning (headaches, dizziness, lethargy, etc.). After the risks for each identified scenario have been assessed, it might seem difficult to choose at first sight which risks are worthy of an immediate corrective action associated with the appropriate investments and which other risks could be considered as tolerable or minor. Therefore, it is helpful to assign scores to the risks to rank them. All that remains is to define the risk's acceptability level. Particularly at this stage, working in a team is a considerable advantage, as the acceptable or unacceptable character of a risk depends notably on the socio-economic context, on regulations, and on the judgement of the individuals who decide which actions to carry out to control the risks. The barriers suggested must take into account the financial criteria (cost of the actions, insurance, etc.), as well as technical (efficiency, reliability, etc.), human (training, time spent on procedures, etc.) and organisational (task assignment, coordination of the approach, etc.) criteria.

In order to reduce the risk to an acceptable level, two broad categories of measures can be identified: prevention actions, aimed at reducing the likelihood of a dangerous phenomenon occurring (e.g., ventilation of building projects and sanitation networks likely to produce off-gases), and protection actions that tend to limit the scope and/or the severity of the consequences of an accidental event (e.g., wearing a mask with a filter cartridge when working in a semi-confined environment). Another solution recommended for its efficiency is of course overcoming the risks at the source by eliminating the hazards.

Along the same line of thought, inherent safety aims to reduce the risks starting at the system's design phase. Increasingly emphasised in process industries, inherent safety is governed by the application of four fundamental principles: minimisation, substitution, moderation and simplification (Kletz, 1978; 1998). These four principles will be examined in the light of the missions and challenges faced by cities and territories.

Minimisation

Often similar to the notion of intensification, this principle involves limiting the amount of equipment, stocks and products to the maximum quantities required for the system under consideration to operate correctly. While one of the impacts of this measure is to reduce the intensity of efforts in the case of a disaster, the primary objective is above all to maintain a reliable level of probability for accidental phenomena.

Thus, better management and distribution of stocks (solvents, phytosanitary products, paints, etc.) makes it possible to limit the flows of hazardous materials between several sites and their transportation by road. Avoiding long storage times also has a positive impact on the quality and stability of products, reducing the likelihood of incidents linked to the use of these substances occurring. In addition, minimising the size of batches means better control of storage conditions (temperature, concentration, pressure, etc.), and makes it easier to regulate these conditions and to take action in the case of a disaster, especially for combustible materials. The fires that affected the Urban Community of Arras (Saint Laurent – Blangy, 62) in 2009 (stocks of tyres and straw caught fire) and the town of Caudan (56) in 2011 (a household waste warehouse caught fire) show the potential benefits of these recommendations.

The principle of minimisation is often applied in relation to transport in urban zones where limiting traffic flows means fewer accidents. It is also applied during the construction of public buildings, for which the quantity of combustible materials is restricted. Minimising also means limiting the use of chemical substances and therefore reducing the amounts of these substances that are likely to be released into the environment, as in the example of using biocontrol instead of pesticides. Another example is reducing amounts

of ferric chloride during the coagulation and sludge stabilisation phases of waste-water treatment. Notably thanks to the use of centrifuges, ferric chloride is now only used for phosphate removal, which considerably reduces its impact as was the case for the 10 m^3 leak of this product that took place in Gevrey-Chambertin (21) in 2009. Finally, a physical reduction in the amount of raw materials used (paper replaced by email, for example) has, of course, a direct effect on the amount of waste to be treated.

Substitution

This involves replacing a hazardous substance with a material that has a lower nuisance potential or replacing a manufacturing/synthesis method with a different method that is safer or that does not require the use of hazardous substances.

One of the best-known applications of this method is recycling, since it involves replacing raw materials with recycled materials, as in the case of cullet (glass debris) and plastic waste. Practiced in certain countries (Israel, Australia, etc.) and tested in several French municipalities (Agde in 2009, Clermont-Ferrand in 2011, etc.), the reuse of treated waste water for irrigating green spaces is also a potential covered by the Order of 2 August 2010. However, given the risk of the dissemination of microbiological and chemical contaminants, this practice is subject to strict recommendations on the quality of the water used and the sprinkling methods (Anses, 2012).

Replacing chemical pesticides with biopesticides (nicotine, pyrethrum, etc.) is another example, as is the use of LED public lighting which consumes less energy than the previous mercury-vapour lamps. In the field of waste water, lagooning processes can, under certain conditions and mostly in rural environments, partially replace more common treatment processes.

GLASS RECYCLING POINT IN AVIGNON
Photo: Jean-Louis Zimmermann

Replacing combustion-engine vehicles with electric vehicles also reduces the risk associated with handling and storing fuels. This observation applies to heating systems (leak of 1,500 litres of fuel oil in Sarrebourg - 57, 2000). However, it is important to remember that any replacement must be accompanied by an additional risk analysis as the prospective replacement object, substance or procedure could itself be a source of a new hazard. In the case of electric vehicles, the toxicity of the fumes released during a fire can be higher than for a combustion-engine vehicle.

Finally, maintenance and cleaning procedures are often vitally important in risk management. For example, disinfecting cooling towers or domestic hot water networks can be done notably with chlorine or ozone products, with ozone having the advantage of not forming organochlorines but not having a residual effect (water pollution in Saint Martin de Belleville - 73, 2005). The release of hydrogen sulphide during the curing phase of settling tanks or networks also presents considerable risks for the health of exposed workers. The accident in Poissy (78) in 2006 which caused 3 deaths serves as a reminder of this. Replacing the one-time draining procedures with advance treatments using calcium nitrate would make it possible in certain cases to significantly reduce the likelihood of such accidents occurring.

RELEASING THE GAS FROM AN OLD PIPE UNDER THE LINES FOR A FUTURE TRAMWAY IN CHEVILLY-LARUE. THIS OPERATION, KNOWN AS "FLARING", INVOLVES SETTING FIRE TO THE GAS UNDER PRESSURE IN A PIPE, THE ENDS OF WHICH HAVE BEEN DISCONNECTED FROM THE REST OF THE NETWORK. ONCE THE GAS HAS ENTIRELY BURNED OFF, THE PIPE IS REPLACED WITH A NEW ONE.

Photo: Val de Marne Departmental Council

Simplification

The main idea behind simplification is to design a system that is sufficiently robust and resistant to external attacks or internal deviations (error tolerance), or to adjust a system to meet these criteria. This can involve using a minimum number of devices and connected circuits, using proven technology for the equipment and favouring a simple configuration for the pipeline and safety systems. Reducing the intermediate storage of hazardous products as much as possible, favouring passive barriers such as pressure-resistant equipment rather than valves are examples of how this principle is applied.

However, a system can only be inherently safer if, during the design phase, instrumented risk analysis measures are included so as to detect the weak signs as early as possible. In addition to a system that is "tolerant" to defects, care must be taken to ensure that preliminary signs of errors or accidents are detected and interpreted. In particular, this can be put in place during the design or review of distribution or collection networks (water, gas, electricity, etc.) thanks to the proper placement of probes and sensors. Being sure to protect a gas network against external attacks with built-in warning devices and fail-safe valves that are set to the safe, stable position if the fluid supply is cut off is another example of this principle (Gas leak at Boissy-sous-Saint-Yon - 91, 2014). In addition, a system that is simpler and more tolerant to errors is more resilient in the face of extreme hazards. Finally, simplifying means also reducing the likelihood of human error occurring by ensuring that a procedure is clear and easy to execute.

Moderation

Moderating means reducing the potential effects and their through the use of hazardous substances in a less hazardous way and/or identifying the options/ conditions for operating in a safer environment.

Examples of this can be found in the use of a detergent in a more diluted form rather than at full strength or when treating plants and green spaces only if the weather conditions limit the dispersion of pollutants (calm conditions, humidity between 60% and 95%, etc.). In terms of road safety, the principle of moderation can obviously be seen in the reduction of the legal speed limit on certain sections considered as accident danger spots. In this same area, another example is the inclusion, from the design or redevelopment stage for urban zones, of passive-safety light fixtures that bend upon impact with a vehicle.

Moderation can also be seen in the eco-design of buildings and facilities when choosing materials and assembly methods. For example, a preference for modular design which would limit the dismantling stages, as well avoiding the use of laminated materials which are difficult to recycle. To this end, the spirit of inherent safety is perfectly compatible with the life cycle analysis (CCPS, 2009).

Initially developed for process industries, the principles of inherent safety can easily be applied to the activities of cities and territories to improve prudence and protection. Although at first glance they may seem simple, these notions are complex to implement rigorously and systematically. Keeping the notions of "minimisation", "substitution", "simplification" and "moderation" in mind for proposing a new urban service, drafting a tender response or developing a territory is a step in the right direction. To go even further, this approach would have to be structured in a way that makes it as complete as possible and would make

it possible to quantify the impact on risk management using relevant indicators. In the industrial field, several methods of doing this have already been suggested, including the INSET tool (INherent SHE Evaluation Tool) created as part of the INSIDE European project (INSIDE Project Team, 2001). A similar method for assessing the measures by combining their environmental, safety and financial aspects on the scale of a territory would be a valuable decision-making support tool.

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THE ROLE OF AUTHORITIES AND TECHNICAL SERVICES IN ESTABLISHING PLANS FOR FLOOD RISK PREVENTION AND CRISIS MANAGEMENT. THE CASE OF ANTIBES-JUAN LES PINS

Photo: Town of Antibes

INTERVIEW WITH VALÉRIE EMPHOUX
Manager of the Rainwater - Flood Prevention Department for the town of Antibes - Juan les Pins
by Christine Gandouin, SUEZ Environnement - Consulting Department

In this interview, Valérie Emphoux shows the diversity of the actions to be implemented to reduce the flood risk. And despite dramatic events, it is necessary to continue to provide information and communication to citizens. Likewise, we must never let our guard down, the risk is always present and requires our constant attention and the continuation of the actions put in place.

ANTIBES, LOCATED ON THE CÔTE D'AZUR, SITS ALONG THE SHORES OF THE MEDITERRANEAN. HOW IS THE TOWN TRANSFORMED WHEN IT RAINS? LET'S LOOK BACK AT THE DISASTERS THAT HAVE SADLY OCCURRED IN THE PAST.

Antibes is exposed to four types of phenomena. First, a fairly long-standing threat, a major burst of the banks of the coastal river, the Bargue. The specific nature of the threat is the small size of the basin, barely 70 km², with a response time of 2 to 3 hours, especially when the ground is saturated.

The second phenomenon involves small coastal watersheds, several km² in size, which cover very urbanised, highly impermeable territories: flash floods. Here, the response time is even shorter, about half an hour, or the intense duration of our Mediterranean storms. Together this creates a decidedly dangerous cocktail, especially as these brief, violent storms often occur without advance warning, and are difficult to anticipate.

The third phenomenon is even more explosive: urban runoff, which is the instant response to storms. Rainwater equipment, not designed for such large amounts of water, is quickly saturated. Water runs off on the surface, turning streets into torrents, flooding public spaces, causing backups in private homes and physical damage. This phenomenon is the most dangerous, the most violent, and the most difficult to manage.

Finally, Antibes, a coastal municipality, is also exposed to the turbulence of the sea, which hinders the flow though small valleys, and to the phenomena of marine submersion.

Let us not forget that the torrential waters and flash floods have taken three lives in this town, in 1979 and 1987. The 1987 event was a shock for the municipality, it was the first extremely violent storm to have occurred after decades of urbanisation and soil sealing. Six years later, the floods of 1993 definitively

ranked the risk of flood as the most significant and most frequent risk facing the town. The floods are still talked about today.

HAS ANTIBES CONSIDERED THE RESPONSE TO THE FLOOD RISK AS AN ACTION WITH SEVERAL FACETS, INVOLVING SEVERAL PLAYERS? PLEASE EXPLAIN.

After the storms of 1987, the municipality launched several major discussions on fighting against floods through an initial development master plan, and took significant measures to compensate for the new soil-sealing activities. The recommended water engineering works were still only in the planning stage when the events of 1993 occurred, causing extensive damage. These new floods mobilised the community once again, this time with a clear willingness to abandon plans that were too ambitious and unrealistic, and to launch concrete, affordable projects.

The flood challenge has become important to everyone:

1. the State drew up the PPRI, approved in 1998
2. the urban civil protection service developed a crisis management response plan
3. Antibes created a department specifically for rainwater management in 2001, tasked with:

- managing and improving the existing rainwater equipment inventory
- carrying out preventive actions involving maintenance of networks and small valleys
- putting in place preventive urban development measures via rainwater zoning and regulations
- verifying that these regulations and those in the PPRI are being applied correctly, training the town hall police on this topic
- carrying out water engineering works to make the town safe
- working together on operational crisis management

WHAT ABOUT THE RESIDENTS? HOW ARE THEY INVOLVED?

Following the historical floods of 1993, those affected came together under the existing neighbourhood associations, or created new ones for that event. Their comments were taken very seriously, especially as part of the regular working groups presided by the elected officials and assisted by the technical services.

More generally, the municipality put the usual informational materials in place.

To comply with regulatory obligations, Antibes holds an information day every 2 years. These events draw a very small number of residents.

The town's website is updated with information about the flood risk, the PPRI, rainwater regulations, the DICRIM, etc. Antibes has access to a system for broadcasting storm notifications to residents: registration is voluntary.

Flood markers are going to be installed: beneficial for the collective conscience

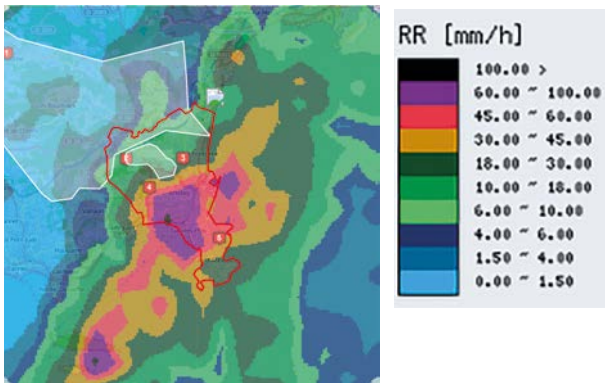
But too often, we face an attitude of denial on the part of residents. As is the case everywhere, people only get involved once they are victims. When we spoke to certain residents about the Draguignan disaster (June 2010), we heard the words "that won't ever happen here".

In terms of awareness, one of our actions was particularly effective, exceeding our objectives. In 2010-2011, a large-scale campaign for detecting PPRI infractions was launched in the Brague floodplain. Most plots and businesses were inspected, and reports were sent to owners and operators, all of whom were "concerned". But in November 2011, when a flood of approximately a 30-year level hit this neighbourhood, we did not receive any claims from these individuals! This action also helped us make them aware of the risk and of their own responsibilities. But such a campaign requires sufficient resources and is difficult to implement on a widespread basis!

YOU SAY THAT IN 1987, ANTIBES DECIDED TO ADAPT, TO SUPPORT THE EVOLUTION OF THE TOWN CENTRE. WHY AND HOW?

Because rainwater projects cannot be constantly rescaled, because work must be affordable, because the town had understood the cost of decades of urbanisation, one significant action was to require measures to compensate for soil sealing when processing building permits, in the form of retention ponds on the plots. Initially, these urbanisation regulations only applied to large areas, they were later extended to all building permits. For several years we have been working on promoting alternative techniques and mitigation measures.

The municipality also specified in its PLU the locations reserved for carrying out protection projects or flood expansion zones.



A LOOK BACK AT THE EVENT OF 10 NOVEMBER 2014: A VIOLENT, LOCALISED PHENOMENON
Photo: Société Novimet

TO SUPPORT THESE REGULATORY PREVENTION MEASURES, ARE YOU ENSURING THAT THE SMALL VALLEYS ARE MAINTAINED?

Yes, in Antibes, maintenance is carried out by municipal teams, including for private small valleys, thanks to a Declaration of General Interest. This service has access to considerable resources since we have qualified agents, a sewer-cleaning truck, small public works machines, etc.

After the Draguignan disaster, we were able to step up to help our neighbours in restoring their rainwater equipment with our human and material resources, a highly meaningful experience for the team members from Antibes.

In terms of prevention, we try to be exhaustive: drain grates, ditches, small valleys, etc., the fight against clogging is one of our priorities.

ANTIBES IS CONTINUING WITH FLOOD PROTECTION WORK: DOES THE PAPI (PROGRAMME D'ACTIONS DE PRÉVENTION DES INONDATIONS, FLOOD PREVENTION ACTION PLAN) SET THE PLAN AND THE STRUCTURE FOR THIS PREVENTION PROGRAMME?

Antibes has indeed become associated with the PAPI, in which the State, the department, the urban community of Sophia Antipolis and the municipalities are involved, with the objective of reducing the human, material and economic impacts of floods.

Our programme of major water engineering works covers several decades. Between 2007 and 2013 (PAPI no. 1), a 30,000 m³ mitigation pond was created, a dog-leg route was rectified on a large valley, and hydrological restoration was carried out at the mouth of the Brague. From 2014 to 2019 (PAPI no. 2), the municipality expects to acquire then demolish a house in the danger zone using Barnier funds, and to continue the studies and works for better management of overflows in the Brague plain, as well as, and most importantly, torrential run-off in small urban ponds.

RAINPOL in Antibes

Antibes uses the RAINPOL® service. This platform provides access to data from a local X-band radar, converted into rainwater depth on the ground. The data makes it possible to anticipate the arrival of threatening storm cells within 30 to 60 minutes, to monitor their movement and to assess the rainfall intensity and the depth of accumulated water in the territory. The civil protection service uses the data to optimise responses (mobilisation of field agents, etc.) and gain precious minutes to react. The Rainwater Department relies on this data for its hydrological and hydraulic analyses.

Source: Town of Antibes

Besides the PAPIs, Antibes is also initiating major rainwater collection works, which require a huge financial commitment with very little in subsidies, in a tight budgetary context for local authorities in the area.

BUT WHEN THE CRISIS TAKES PLACE, HOW WILL IT HAPPEN?

Antibes has an urban civil protection service. We have pooled our respective skills to put in place tools and resources for alerts, monitoring and decision-making support. I am referring to field agents in the rainwater department who know the black spots and are the first to be mobilised in a crisis, I am referring to the water-level sensors that trigger alerts when thresholds are exceeded, I am referring to the RAINPOL platform, which is a true asset in hydrometeorological monitoring, as it makes it possible to anticipate the arrival of storm cells, assess the severity of the storm and track its movement.

PREVENTIVE MAINTENANCE OF SMALL VALLEYS BY MUNICIPAL AGENTS
Photo: Town of Antibes

CAN WE LOOK BACK TO THE EVENTS OF 10 NOVEMBER 2014?

November 2014 was a very rainy, chaotic month. Several influxes from the Cévennes mountains have affected the Mediterranean area, Nice, Héraut, Tarn, Var, etc. On 10 November at noon, the storm broke over Antibes: 47 mm in half an hour, 65 mm in an hour, we qualified that as at least a fifty-year event.

Since the start of the month, the municipal teams had been on standby, especially as the ground was saturated from previous rainfall. But on 10 November at noon, the department of Alpes Maritimes was not placed on "orange" alert.

The storm cells, monitored by the RAINPOL platform, arrived from the west and crossed the lower, more urbanised section of Juan les Pins at La Fontonne. Urban run-off and flash floods in the small valleys became widespread.

The Antibes civil protection service closed flooded roads to traffic, evacuated 3 people, coordinated the municipal departments (municipal police, rainwater, roads, sanitation, etc.) for the safety of users, and activated the post-flood clean-up of roads, for a quick return to normal. SDIS 06 (Alpes Maritimes departmental fire and emergency service) was put to full use, and implemented all resources available for pumping in the municipality in order to dry out the flooded buildings and basements.

A request was made for a natural disaster to be declared.

After the flood comes the time for restoration and repair, diagnosis of the problems, explanations about the damage that the victims try to attribute to a malfunction! The distress and anger of the victims mean there is a great need for education.

AFTER 20 YEARS OF REFLECTION, CAN YOU SAY THAT THIS APPROACH HAS MADE ANTIBES SAFER?

Each storm is different, its location, intensity, etc. do not result in the same impacts, so it is impossible to make accurate before/after comparisons. But the management implemented in the territory has undeniably reduced the consequences and the severity of the floods.

I am convinced that the measures taken have made the town safer.

- implementing preventive measures with urbanism regulations: difficult to quantify, but mitigation is evident
- carrying out preventive maintenance actions for networks and small valleys: effectiveness is ensured, it is highly worthwhile as we can be sure that the equipment is working to maximum capacity, that the risk of clogging is minimised and that drying occurs quickly
- verifying the proper application of regulations (PPRI, etc.): here it is a question of avoiding or at least slowing down a worsening in run-off and in the flow conditions for floods
- carrying out the required water engineering works for making the town safe: the projects

completed (retention pond, diffluence, etc.) help reduce peak flow rates upstream, encouraging water discharge downstream...

- setting up operational crisis management: pooling skills has made it possible to optimise responses On 10 November 2014, only physical damage (cars, flooding on ground-floor and basement levels, etc.) was reported.

At the request of the Mayor, a full report on the latest floods will be published in the municipal magazine to focus on the actions taken by the municipality, which largely contributed to the fact that 10 November 2014 did not have any dramatic consequences. The work carried out in the background every day must be recognised , and above all, maintained, because it would be unacceptable to reduce these efforts by reaching the premature conclusion that the situation is under control.

URBAN RUN-OFF ON THE GRASSE ROAD ON 10 NOVEMBER 2014
Photo: Town of Antibes

HAS THE TOWN BECOME MORE RESILIENT, THANKS TO THIS ARSENAL?

It has helped, clearly, but there is still much to be done to make the town more resilient. We have to educate the elected officials, technicians, citizens, etc., as well as the media, to work towards resilience as the basis is acknowledging the risk. Before a crisis, too many residents are in denial of any risk, and after a crisis, a large number of victims in areas that are naturally flood prone are quick to seek to lay blame.

But it is obvious that we need to work to make the town more resilient. However, we must continue to carry out projects to reduce the exposure of the population, to reduce the impact on property, and especially to continue the hard work in terms of prevention, so that new vulnerabilities are not created!

It is also our duty to consider town planning, so that when there is a major storm, the situation does not become too difficult.

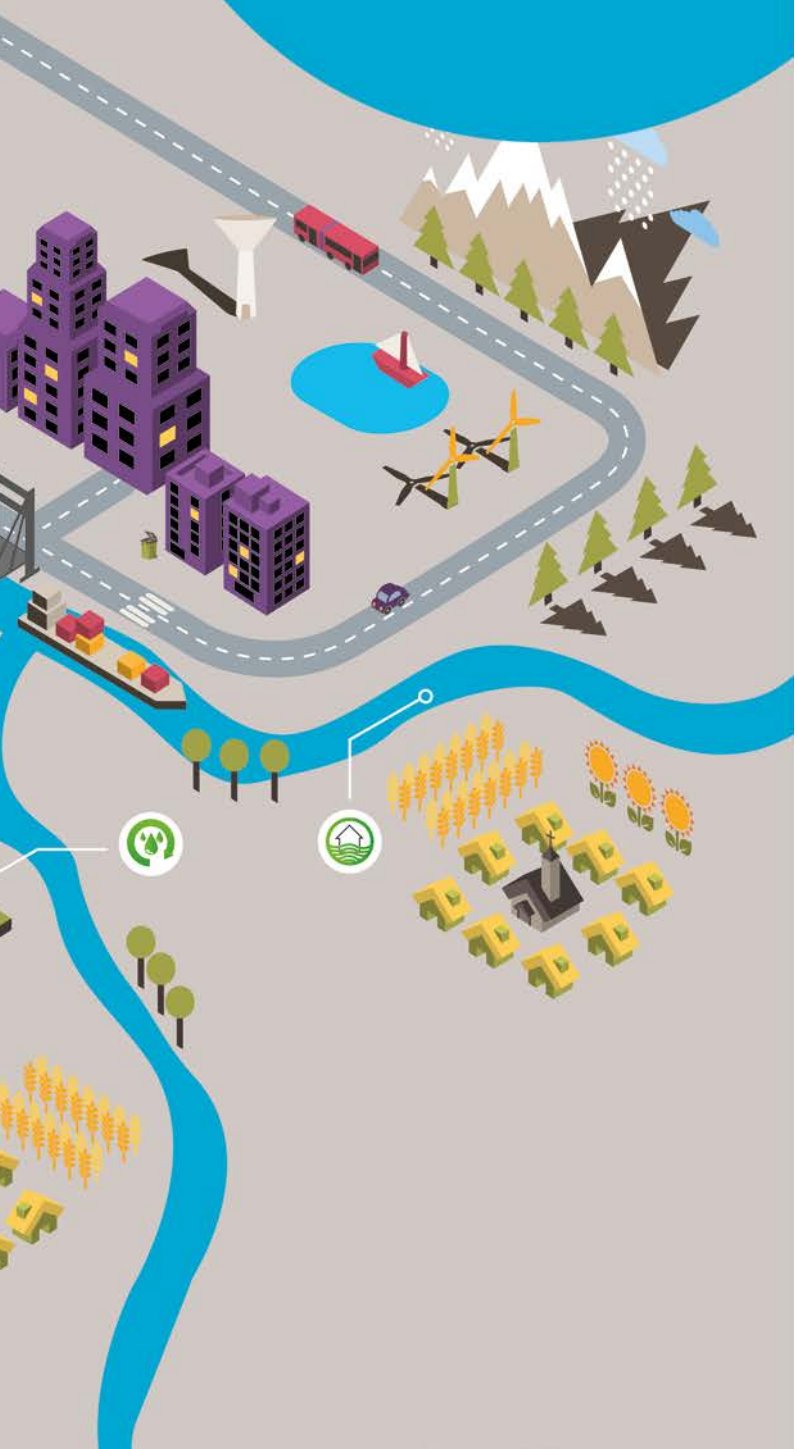
HOW CAN THE COMMUNITY WORK TOGETHER TO MAKE THE TOWN EVEN SAFER?

From a regulatory point of view, we don't yet have the resources to retranscribe in the urban planning tools, the trends reported in the climate plan and the flood guidelines, such as the awareness of a worsening in the risks for the low coastal zones. We continue to rely on the town planning rules set in our already old PPRI, and which perhaps no longer offer adequate prevention. In addition, urban run-off is not taken into account in the PPRI, and the danger of this phenomenon is not studied adequately.

Maybe the revision of the 1977 technical Instruction could include a run-off section: encouraging the identification of what happens when the networks are completely saturated, offering urban planning methods that take this risk into account. Local authorities and planners need these technical reference materials.

CHAPTER 3:

THE ROLE OF USERS IN PRUDENT AND PROTECTED MUNICIPAL SERVICES



A town cannot become prudent and protected without the active participation of users or citizens. Municipal public services will not find the answer to the challenges of climate change without relying heavily on the willingness of users or citizens to be a driver for change. But prudence involves changes in behaviours that are difficult and sometimes far removed from the habits of a consumption society. Local authorities must therefore play the role of facilitator and find the right level for reconciling rationalisation and proximity.

Nantes has implemented voluntary ecology and energy transition policies. Laurent Coméliau describes the main points. It is an approach marked by the proximity of residents and a special focus on resources. But this policy also targets users who are beneficiaries of a service, as well as citizens, who are players in the city. Finally, the local authority must bring together and assist citizens or users, the major players in change.

→ p.97

In a context where the management of water as a resource is being questioned in terms of a steady supply or water savings, the rationalisation of water services seems to be a suitable response. Rémi Barbier points out the advantages and disadvantages of such an approach. And in particular, this plan does not meet the need for local adaptation of local services vis-à-vis the user and the local political will. Issues involving the scale of the water service become decisive.

→ p.102

The Triassic sandstone water table is currently over-exploited, to meet the needs for potable water, for agriculture or for industrial activities. Juliette Cuny and Marie-Noëlle Pons describe the lengthy process of awareness and the way in which all players took ownership of the problem in order to find solutions. Regulatory actions and voluntary actions by local authorities or individuals are complementary and should make it possible to match, in the long term, the exploitation of the Triassic sandstone water table to its natural replenishment.

→ p.105

The interview with Pierre Biche is testimony from a user of public services: water, electricity, waste collections, etc. And regardless of the service, the solutions offered for increased prudence are not simple. Balancing a responsible attitude, consumers' desires, behaviour to be changed or a higher cost is not easy. Daily habits are an obstacle to the desire to act in good faith.

→ p.108

Finally, Michel Richard reminds us of the importance of citizen involvement by users in monitoring the quality of municipal services. With the creation of user committees, forums for dialogue allow for collective improvement between the organising authority, the operator and the users of public services. In Grenoble, the users committee is an element of governance that is welcomed by all and that seeks to adapt with the institutional evolution of the MAPTAM act with a transfer of "water" authority from Grenoble to the Metropolis.

→ p.111

USER-CITIZENS AT THE HEART OF THE PRUDENT CITY

by Laurent COMÉLIAU, head of the Sustainable Development and Climate Activities Hub, Nantes Metropolitan Area

Nantes Metropolitan Area and the city of Nantes are leading plenty of initiatives to make the city more prudent and more sustainable. One of the key elements seems to be based on the citizen, an important player in the city. The local authority is no longer positioning itself as a player, but as facilitator, supporting and assisting the individual or collective initiatives.

Territorial climate energy plans, waster prevention plans, water policies, urban travel plans, to mention but a few, are all initiatives carried out by cities to face the challenges of ecology and energy transition.

They are based on two pillars: one made up of municipal services with their physical network structures (collection of waste or waste water, transport, distribution of water or energy) and the other made up of actions relating to awareness, education, encouragement, dialogue between stakeholders (leadership and communication activities, advice, dialogue between players, etc.). These represent the "hard" and the "soft", inseparable and complementary to make the sustainable city whole.

Targeted by these services both as users but also fully involved players in the prudent city as citizens, the residents of the territories play a key role which is attracting more and more attention from local authorities. That is what this contribution to the debate on "prudent and protected towns and territories" hopes to illustrate, using the concrete practices underway in the Nantes Metropolitan area as a gauge.

NANTES - VIEW OVER THE LOIRE AND THE BOULEVARD GASTON DOUMERGUE
Photo: Emmanuel Parent

Systems, organisations and players undergoing change

To characterise the changes that take place during energy transition, Gérard Magnin, an expert in territorial energy policy, lists opposite meanings of terms, in a deliberately simple way, and that can be summarised as follows[39]:

Before the transition, an approach marked by	*Today, an approach through... ?*
• supply	• demand
• centralisation/vertical	• decentralisation, horizontal
• large size	• small size
• megawatts	• negawatts
• fossil & fissile energies	• renewable energies
• carbon energy	• carbon-free energy
• technocracy	• democracy
• sectors	• the players
• the State	• the markets, the local authorities
• the consumer	• the citizen

This presentation is not black and white, but the take-away message is that it represents a trend towards organisational methods and technologies that are more supple and flexible, created with greater participation from local players and residents with greater proximity and with renewed and strengthened types of connections with local resources.

In this way, the "major" municipal services are increasingly forced to coexist with more individualised systems: recovering rainwater, composting organic waste, or decentralised energy production where the resident is more directly involved in the procedure.

The "user-citizen" resident, sometimes a user, sometimes a resident

The public policies introduced by the Nantes Metropolitan Area and the city of Nantes place "the citizen-user at the heart of the public service provided" with a "dual democratic (citizen dialogue) and pragmatic (service provided to the user) imperative", because "the residents would not know how to be treated as only beneficiaries, clients or consumers"[40].

When the Metropolitan Area of Nantes develops biomass networks that will, in 2017, make it possible to serve 50% of the city's social housing units at a controlled cost while helping to meet almost 9% of the objective in the Metropolitan Area's Climate Plan, we are indeed in a primarily *user* approach.

On the other hand when the Metropolitan Area works to provide individualised support to 35 private joint-owned properties with poor energy use - i.e. 5,000 housing units in late 2014 - to encourage the properties to start work, the distinction between user and citizen is more blurred. Certainly the resident benefits, from a collective point of view which is joint-owned property, from a service of support and advice offered by the local authority, but the parameters leading to the decision to initiate the work (financial support, return on investment, vote in a general meeting, etc.) and the number of stakeholders (architects, artisans, trade union, trade union council, energy design offices, etc.) lead to greater accountability on the part of the resident.

[39] Wednesday NET/CNFPT meetings, "energy and climate, transition or revolution for local authorities", November 2014

[40] See the Editorial of the knowledge report on "Dialogue Citoyen : faire ensemble l'action publique locale?" ("Citizen dialogue: carrying out local public action together?") January 2014, City of Nantes

The same is true for waste. The organisation of the public waste collection service and waste sorting centres is primarily carried out according to a *user* logic. Incidentally, it is worth pointing out that feedback from users on the quality of the service provided is decisive in best adapting the service to the local authority, if applicable, managed by the operators. Client satisfaction surveys or direct dialogues between refuse workers and residents are types of "feedback" that are used increasingly as a matter of course.

On the other hand, the emphasis is placed increasingly on the citizen when it comes to managing waste prevention. Here too, a multitude of stakeholders are involved (associations, integration and re-employment entities, mass retail sector, etc.).

The travel policy is not immune from the same observation. Network structures such as tramways or bus lines follow a *user* logic, but the resident-citizen-user is increasingly sought and present. The Bicycle Plan put in place in 2011 encourages their participation via Nantes neighbourhood councils, as a result of which 1.9 million euros have been dedicated to carrying out pedestrian- and bicycle-friendly developments that the residents see as a priority. Another example: 359 companies employing 94,000 workers have committed to mobility plans led by the Nantes Metropolitan Area.

The smart and prudent city also strongly challenges the role of the user-citizen. Patrick Rimbert, Mayor of Nantes from 2012 to 2014, would often emphasise that a "Smart City" is primarily the result of "Smart Citizens". In other words, the local authority can of course make the city easier and more economical for the user, for example with new smart sensors (such as linky energy meters) or information services (mobile apps) that are easily adaptable. But it is also the expression of intelligence on the part of the players that should be encouraged. In this way, access to and pooling of the public data from Nantes and the Nantes Metropolitan Area in late 2011 resulted, in particular, in the emergence of a collaborative application such as *GreenRaid*, a digital platform for identifying sustainable lifestyle destinations in Nantes.

Photo: ©GreenRaid

Public services as supporters and facilitators of citizen initiatives

The co-responsibility of a territory in the face of sustainable development challenges leads cities to facilitate the synergy of various players, companies, education and research centres, farmers, associations and residents, based on shared objectives and actions that the players can themselves initiate.

The goals of the Nantes Metropolitan Area Climate Plan, targeting a reduction in greenhouse gases in the territory of 30% per resident by 2020 in comparison to 2003 and by 50% by 2030 can only be upheld thanks to the collective mobilisation of the players. In particular, the scope of the emissions from players in the territory (about 60% to 70% of the total emissions in the territory) targets movements by citizens - understood here in the broadest sense of the term: associations, companies, residents. The scope for public policies (20% to 30%) relates to services provided for users-citizens. Finally, the scope of emissions for the territory's heritage (about 5%) - buildings, vehicle fleets, operation of the administration - challenges more specifically the local authority in its requirement for exemplarity and its role as agent in its citizen dimension.

Therefore, local authorities take on an enhanced role of facilitator and agent for unity, to better support the territories in their ecology transitions, beyond just the direct levers that are the urban public services.

The possible methods for action in this area are generally still being sought, are diverse, their impacts are not always easily quantifiable and they are complex to generalise. Local authorities which are active in these initiatives ensure good progress, specific to each innovative action that involves experimentation, assessment then replicability.

In the Nantes area, several dynamics continue along this path. The local authority can be the initiator or simply a partner. For example:

- Citizen project tenders that make it possible to initiate, reveal and facilitate the emergence of projects led by residents, as was the case for the 87 projects supported by the Nantes Metropolitan Area and the city of Nantes for Nantes European Green Capital 2013 and as will be the case with the Vélocity 2015 project tender.
- The search for action in a partnership for energy transition, led by the Ecole des Mines de Nantes engineering school with the support of the Metropolitan Area, which, following citizen debates that brought together 2600 participants in 2012-2013, seeks in particular to create a local network of energy advocates.
- Défi Famille à Energie Positive ("Positive Energy for Families" Challenge), a national project which has been substantially supported for the last 3 years by the Nantes Metropolitan Area and which brings together volunteer participants to reduce their energy and water consumption by at least 8% in 5 months through daily measures. Actual results show that families in the Nantes Metropolitan Area reduced consumption by an average of 18% in 2014. The 2013-2014 initiative included 7,500 families in France, of which 172 were from the Nantes Metropolitan Area. The analysis of the data from the challenge has been assigned to a postgraduate student with financing from ADEME and the Nantes Metropolitan Area[41].

CLOSURE OF THE DÉFI FAMILLE À ENERGIE POSITIVE ("POSITIVE ENERGY FOR FAMILIES" CHALLENGE) 2012-2013
IN THE PAYS DE LA LOIRE REGION

Photo: Alisee

- Since 2012, together with and at the request of about a hundred residents, the city of Nantes and the Nantes Metropolitan Area have embarked on creating maps of local "sustainable development services" in Nantes neighbourhoods. In this project, drawing on citizen expertise in terms of use aims to identify the strengths and weaknesses of the resource points available to all, whether they are managed publicly or not. This involves waste management points, equipment and routes for soft transportation, consumption points for local, seasonal products, resource centres for saving water and energy, and community nature and gardening spaces.

[41] Evelyne Cordeau, data analysed as part of the thesis project on "the role of socio-economic variables and values in the evolution of household behaviours in the face of climate change: implications for local public action".

A FRIENDLY ATMOSPHERE AT THE ECOSPHERE COMMUNITY GARDEN, NANTES

Photo: City of Nantes

Recognition of citizen expertise, and more generally of initiatives led by other stakeholders (including by other territorial authorities, from the municipality to the region and the central services of the State) requires a change in attitude and even in professional practices, to truly "want to work together". This stems considerably from the climate of trust that exists between the players acting on the same territory.

While in terms of ecological prudence excess consumption of natural resources is hazardous to health, we cannot over-emphasise the intoxication of dialogues with and between players in the territory, regardless of the hat they are wearing: citizens, users, citizen-users and other stakeholders. As long as, however, these dialogues do not turn in circles but always result in concrete visions and achievements shared by and for the greatest number of people in terms of social justice, saving resources and long-term economic balances.

It is under these conditions that the slogan "users, citizens, prudence" could be inscribed on the monument to ecology transition.

THE SCALES OF "WATER SECURITY"[42]

by Rémi BARBIER, professor at ENGEES, director of the UMR Irstea-ENGEES GESTE
Gestion territoriale de l'eau et de l'assainissement (Territorial management of water and sanitation)

To meet the challenges of rationalisation (of resources, of economic management, of heritage) of water services, it seems natural to group services together and to concentrate water resources. But this highly technical vision is hindered by the user's need for proximity and the need for a local solution.

In many countries, nowadays the issue of water tends to be considered in terms of a water security problem, part of the international agenda since the second World Water Forum in 2000. Many definitions of water security have been put forward, with varying scopes of application (Cook and Bakker, 2012). In our view, targeting our thoughts on the potable water supply service, water security could be defined as the *capacity to sustainably guarantee the permanent availability of a sufficient quantity of water, which meets quality standards, at an acceptable cost and while preserving the integrity of resources and environments.*

This water security issue could initially be addressed and resolved at the level of each service, with measures that combine for example an extension of the scope of protection of the resource to the areas where the catchments are supplied, the intensification of the treatment of raw water and the interconnection between the distribution networks. But we are also seeing the launch of a hegemonic discussion that is turning "hydro-territorial rationalisation" into the keystone for more effective security. More specifically, this is based on two prominent points which combine long-standing trends and more recent shifts: first, a change in scale at the service's organising authorities, and secondly, a concentration of the potable water supply on resources described as "strategic" in one capacity or another.

This rationalisation offers a certain number of benefits, and the services restructured according to this gauge are naturally the first presumed beneficiaries. Rationalisation must first of all make it possible for them to exceed technical efficiency thresholds, and thus achieve improved operation of facilities that are burdened with increasingly strict requirements. Next, rationalisation must globally increase the public services' capacity for action on several levels:

- managing the relationship with external partners (suppliers and agents, agriculture domain), thanks to the ability to recruit qualified personnel
- better asset management thanks to access to sophisticated management methods and to the levelling out of expenses for renewing the networks
- resource management via pooling "resources that are most suitable for providing quality and continuity guarantees" (Canneva and de Laage, 2013)
- finally, rationalisation must generate economies of scale, for the benefit of the end user. However, analysis should be accompanied by a certain amount of caution regarding this rhetoric of promise.

[42] This contribution is the result of a collaborative project managed by the author as part of the Aquadep initiative, financed by the Eaux et Territoires (Water and territories) programme.

[43] Nous utiliserons de manière équivalente sécurité hydrique ou sécurité en eau, étant entendu qu'il s'agit bien ici de l'eau potable.

Photo: Guillaume Coqueblin

Firstly, rationalisation is also promoted by and initiated for other potential beneficiaries besides the end user, even if this aspect is not highlighted as much as the previous one. Thus, territorial players (Departmental Councils, Water Agencies, decentralised services of the State in particular) see here a means for limiting their transaction costs by limiting the number of partners, but also for some the level of their commitments via economies of scale and the increase in skill of the structures thanks to rationalisation.

Secondly, the expected effects of rationalisation are in no way automatic, and they are not only positive. Thus, it is not only access to a critical size that leads for example the organising authorities to an active policy of protecting the resource by negotiating with farmers: clearly, the social mobilisation of associations has contributed significantly to this. Next, if we take the issue of economies of scale, mobilised as a strong argument for the rationalisation project, the literature hardly offers clear-cut results for a possible "optimum size" for a service, or for an "optimum" level of operational integration, between water production and distribution, or between potable water and waste water. Rather, the literature emphasises two elements: on the one hand, the existence of a threshold above which the benefits of a change in scale become blurred, or even become reversed, and on the other hand, the highly localised nature of the effects, which depend on both the physical as well as the institutional and political context (Ferro, Lentini *et al.*, 2011). The benefits of rationalisation for users also depend on the capacity to combine services that are not similar for greater operational capacity: "two weak services that are combined do not make a strong service", as certain players in the domain like to say.

In addition, several problematic effects can be addressed or anticipated. Rationalisation is likely to lead to a concentration of power over water, within techno-structures subject to low "accountability" requirements and subject to a weak counter-power of associations which usually mobilise locally to scrutinise the accounts and question the service management methods. Next, concentrating the supply on "strategic resources" can lead to the creation of interdependences between supply services and territories outside their boundaries. These interdependences could lead to potential friction in terms of development constraints that will be considered by the protection measures. At the same time, the potential abandonment of resources that are considered not strategic for potable water sketches an outline of where water quality would be left to diffuse agricultural pollution, a reduction in which is no longer a priority. This rationalisation creates new weaknesses, in connection with the dependence on a limited number of resources and large interconnected infrastructures.

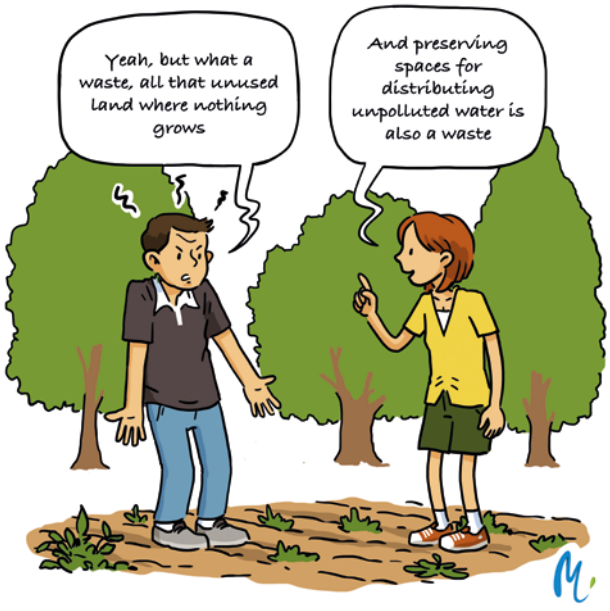


Photo: GRAIE - www.eaumelimelo.org

Finally, the plan for security by rationalisation is met with resistance from many elected representatives with authority for water, for a variety of reasons. First of all, technical and political obstacles. In particular, when services to be brought closer together have in

the past carried out very different policies in terms of asset management, they therefore come to the negotiating table with highly unbalanced "dowry" and needs (Roussary, 2013), which often raises the problem of solidarity. Next is the conviction that the promoted model, the model of "large-scale service", is not what corresponds to local interest, in particular in terms of another requirement, that of proximity, which requires the presence/commitment of a local elected representative considered in effect by the users as the guarantor of this essential service. Elected representatives claim that proximity demonstrates responsiveness, suitability of the service for local realities and needs, as well as proof of a form of shared interest and responsibility for water. Recourse to the proximity argument is even more significant because this notion, which happens to be highly multifaceted, has gradually spread over the more general context of public action as a guarantee of responsiveness, efficiency and, at the end of the day, legitimacy (Lefebvre, 2006). In practice, the imperative of rationalisation thus needs to join with the imperative of proximity, a long-standing component of local technical and political cultures and which today has taken on new features.

LEACHING BASIN FOR THE GAMARDE SPRINGS
Photo: Urban Community of Bordeaux

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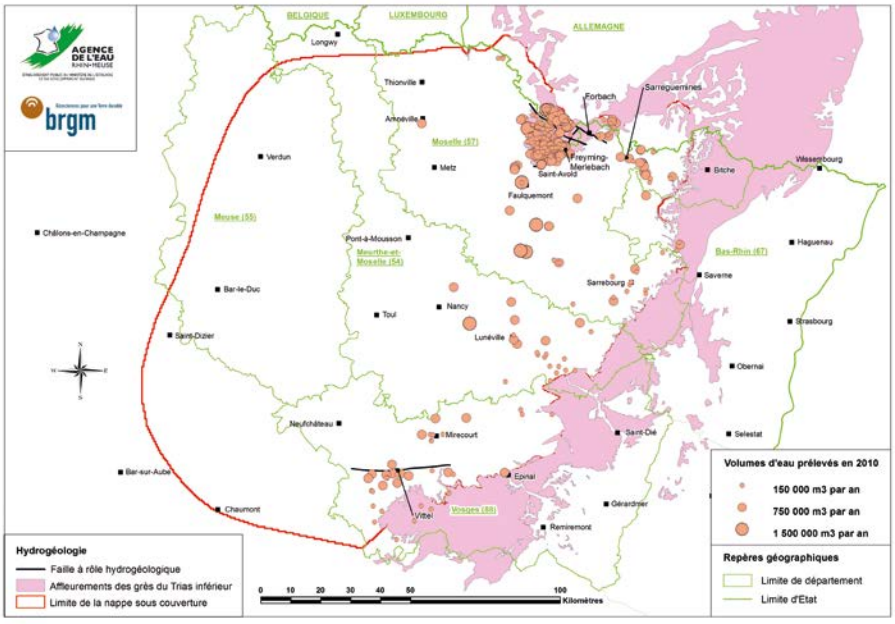
LONG-TERM MANAGEMENT OF THE LOWER TRIASSIC SANDSTONE WATER TABLE IN LORRAINE

by Juliette CUNY, Vosges General Council and Marie-Noëlle PONS, CNRS-Lorraine University

The Triassic sandstone water table extends over a very large area, stretching far beyond administrative boundaries. But through the implementation of regulatory (limiting abstractions, SDAGE) or special tools by the local authorities (SAGE), the actions undertaken should make it possible to use the water table indefinitely.

The lower Triassic sandstone (grès du Trias inférieur, GTI) water table extends from Les Vosges in the south to Germany and Luxembourg in the north[44] (figure below). The volume of water in the lower Triassic sandstone reservoir is assessed at 30 billion m³ at the surface (SDAGE[45] Rhin-Meuse, 1996), and at 500 billion m³ below ground, including 150 billion m³ of fresh water which can be processed into potable water, the mineral content of the remainder being too high. As the primary underground water reservoir, the water table is strategically important for the Lorraine region. It has been used since the early 20th century, and more specifically since the 1950s. Initially, it was used as a supply for potable water, manufacturing water and for mining operations (dewatering for mines). In the 2000s, the total for all water abstracted from the GTIs water table reached almost 110 million m³ per year, mostly in the north of the Moselle River and in the German portion of the Sarre (more than 90%). Use intensified in the 1960s-1970s and significant drops in the piezometric levels of the confined aquifer were recorded in the coal basin and to the south of the Vittel fault.



HYDROGEOLOGICAL MODEL OF THE MANAGEMENT OF THE LOWER TRIASSIC SANDSTONES IN LORRAINE
REPORT BRGM/RP-51355-FR. 57P

Source: Vaute L. (2003). Adapted from BRGM

[44] http://www.lavigiedeleau.eu/node/556

[45] Schéma Directeur d'Aménagement et de Gestion des Eaux (Water Development and Management Plan)

In Les Vosges, the water table is found in the west of the department. The creation of bore holes in the sandstone here started in the 1960s in the Vittel-Contrexéville sections to support the development of mineral water exploitation. Exploitation of the Vosges sandstone water table then spread to, among other areas, the Mirecourt, Bulgnéville and Martigny-les-Bains sections to ensure a supply of drinking water for residents. The significant increase in the number of bore holes from the 1960s to the 1990s quickly led to considerable reductions in the levels of the water table, a testament to over-exploitation in the department of Les Vosges.

This general drop in piezometric levels in the west of Les Vosges is in fact due to the dual effect of a significant number of water abstractions and a specific hydro-geological context. The water table's supply capacity is in fact limited. On the one hand, the surface area of the outcrops is low and a section of these outcrops is found in a dip reversal (catchment basin of the Saône, supply zone for the Vittel - Contrexéville basin). On the other hand the southern strip of the GTI water table is compartmentalised due to the presence of the Vittel fault, considered as impermeable.

Since the 1960s the public authorities have paid particular attention to monitoring the evolution in the water table's levels. On 18 May 1981 an initial decree was imposed on the Vittel-Contrexéville-Mirecourt section to limit abstractions by requiring authorisation from the prefecture for bore holes more than 40 meters deep.

Then Decree no. 2003-869 of 11 September 2003, relating to the extension of the Zones de Répartition des Eaux (Water Distribution Zones, ZREs), identified the GTI water table in the cantons of Bulgnéville, Charmes, Darney, Dompaire, Lamarche, Mirecourt and Vittel as showing an imbalance between the abstractions and the natural replenishment of the water table. On 8 July 2004, an order from the prefecture was imposed on these seven cantons, classifying them as ZREs, thus preventing the construction of new bore holes and strengthening the rules for abstraction of the resource.

The SDAGEs for Rhine-Meuse and Rhône-Mediterranean-Corsica required the implementation of a SAGE[46] at a minimum over the ZRE zone address the quantitative imbalance. So, on 19 August 2009, the scope of the SAGE was defined and included the Water Distribution Zones by adding the canton of Monthureux-sur-Saône which participates in the infiltration of the GTI water table for the Vittel-Contrexéville water table. The GTI SAGE brings together 191 municipalities, i.e. about 60,000 residents and represents a quarter of the surface area of the Les Vosges department.

In 2010, the Commission Locale de l'Eau (Local Water Commission, CLE), a mini water parliament, was created to successfully complete the SAGE project and to provide local governance for the Les Vosges sandstone water table. The Commission has 45 members, including:

- 23 members representing the elected officials of the local authorities in the territory and the local public establishments
- 13 members representing the users, land owners, professional organisations and associations
- and finally 9 members representing the State and its public establishments

The support structure for the SAGE is the La Vigie de l'Eau (Water Lookout) association[47]

Citizens are involved in the SAGE project on two levels: during the public survey about the SAGE project (after its approval by the CLE and the basin committee) then during the implementation of the SAGE plan of action.

Although it has not yet been put to vote, the scenario of actions strongly highlights all water saving measures:

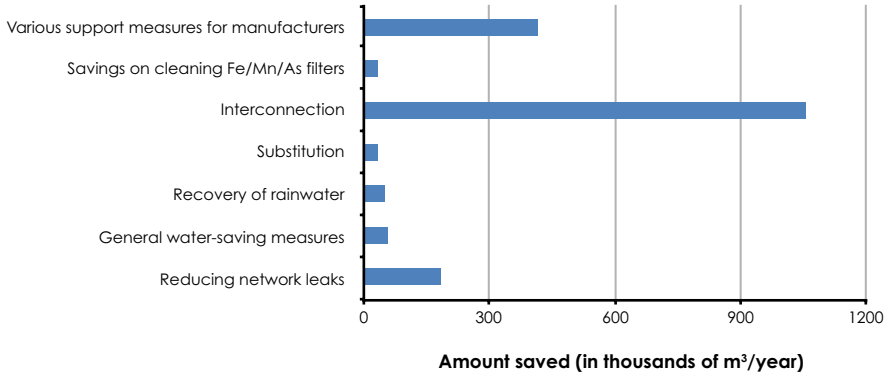
- in private homes for domestic use via awareness and the installation of water saving kits, for example
- at the premises of water producers and managers though improving the distribution network outputs (the average output of the networks carrying water from the GTIs is currently 73%)

[46] Schéma d'Aménagement et de Gestion des Eaux (Water Development and Management Plan)
[47] http://www.lavigiedeleau.eu/sage-gti/

- at manufacturing facilities through the recovery of rainwater or the reuse of treated waste water

The second theme for actions involves the implementation of substitution resources in particular by using local water resources (reuse of water from former springs), by farms. Substitution measures that are broader in scope are planned, with the transfer of several hundred thousand m^3 of water per year. This resonates less with "prudence" but is compatible with the maintenance of ALL uses (half of the water taken from the deficient section is for industrial use: water supply for the Bulgnéville cheese-making plant, manufacturing and bottling water for Nestlé Waters Vosges).

The figure below summarises all measures likely to be implemented by 2025-2030 to improve management of the Triassic sandstone water table.



POTENTIAL WATER SAVINGS ACCORDING TO MEASURES PLANNED

PRUDENCE AND ACCEPTABILITY FOR USERS OF MUNICIPAL PUBLIC SERVICES: THE EXAMPLE OF A USER FROM THE NANTES METROPOLITAN AREA

INTERVIEW WITH PIERRE BICHE
former Ademe Pays de la Loire regional representative, member of the Nantes Metropolitan Area Development Council

by Philippe Marest, Nantes Metropolitan Area

Prudence in terms of public services requires a change in behaviour. The desire to produce less waste, consume less electricity or use potable water sparingly is a community effort. But putting this into practice is difficult because it depends on strong motivation, sometimes in contradiction to deep-rooted habits.

A- Notion of acceptability by the user in terms of waste reduction

WITH THE OBJECTIVE OF REDUCING WASTE AT THE SOURCE, ONE INITIATIVE INVOLVES SUPPLYING AND PROMOTING UNPACKAGED PRODUCTS. DO YOU THINK THAT THE USER IS READY TO ADAPT AND ACCEPT THIS CHANGE?

This is already happening. I am thinking of markets and certain organic shops that practice sales in bulk. I am sure there are other areas and other types of products where this would be possible. As proof, you only need to think back to how the use of bags at the till has declined tremendously, thanks to the initiative of one mass retailer, it must be said.

But at the same time there are considerable gains possible based on an analysis of the various functions of packaging. For example, the primary if not sole function of the large blister pack containing a few small objects is to prevent theft. There is no reason why, after paying at the till, I should be required to handle this cumbersome package until it reaches my dustbin.

The same is true for outer packaging in many cases.

TO ANTICIPATE THE INCREASE IN THE COSTS OF TREATING HOUSEHOLD WASTE, SOME LOCAL AUTHORITIES ARE OPTING FOR ON-BOARD WEIGHING OF HOUSEHOLD WASTE WITH A FEE THAT DEPENDS ON THE VOLUME OF WASTE PRODUCED BY THE USER. DO YOU THINK THIS INITIATIVE IS A WAY TO HOLD USERS ACCOUNTABLE FOR THE WASTE THEY PRODUCE, DOES IT ACTUALLY PROVIDE MOTIVATION?

Yes, I think so. Trials involving this method have now been conducted for long enough and extensively enough to determine the conditions for success, the hurdles and the limits.

But the primary condition for success is education, at the start and over time, including the identification of alternative solutions.

Scrap heap in Berlin
Photo: Sebastian Müller

IN TERMS OF COLLECTION, DO YOU THINK REDUCING THE FREQUENCY OF WASTE COLLECTION IS READILY ACCEPTED BY USERS? AND IF SO, WHAT WOULD BE THE LOWEST ACCEPTABLE FREQUENCY?

I don't think there are consistent answers to this question, as the factors that determine the acceptability limits are many: available space for storing waste in the home, dustbins in the entrance to the building, the quality of the dustbin storage area or lack of storage, especially in terms of odours... Also, don't forget that there are still very significant variations in frequency from one local authority to the next and so viewpoints are also very different.

In this field as in others, decision makers understandably react according to their own living conditions, which are not necessarily representative of those of the average citizen.

DO YOU THINK THE USER CONSIDERS THIS AS A GENUINE DROP IN THE QUALITY OF SERVICE OR THAT THE USER IS READY TO UNDERSTAND THE ACCOMPANYING PRUDENCE-RELATED INITIATIVE?

Which side of the personality that is part of the make up of each of us is going to react most strongly, and when? The taxpayer who pays a tax or a fee, the environmentalist who is more or less convinced, the user who is faced with an obligation? Investing in education is as important as the material investment.

B- Notion of acceptability by the user in terms of the continuity and quality of services

IMPLEMENTING THE CONTINUITY OF SERVICES (WITHOUT SERVICE INTERRUPTIONS SUCH AS FOR EXAMPLE WATER OR ELECTRICITY DISTRIBUTION, WASTE COLLECTION, ETC.) IS A SIGNIFICANT INVESTMENT FOR PUBLIC SERVICES. IN VIEW OF SERVICES THAT ARE MORE PRUDENT, SCALED DIFFERENTLY AND IN A MORE ECONOMICAL WAY, DO YOU THINK AN INITIATIVE THAT WOULD REPRESENT A DROP IN THIS CONTINUITY OF SERVICE IS ACCEPTABLE TO USERS?

The non-continuity of water and electricity distribution and of the sanitation network is truly hard to imagine, except for cases of severe crises or shortages, given the current state of technology. Also, we need to agree on the notion of continuity of service. We are convinced that these services are fully available, at full capacity, anywhere and at any time.

It is on this basis that we need to explore the possibilities offered by the "smart grids" being developed in the field of energy but which are also applicable to other domains, and the new perspectives that open up once we start to think of the service from a decentralised point of view or once we bring into play an almost instant interaction between supplier and user. But this implies a mental revolution first and foremost in the mind of those who own current technologies and services.

DO YOU THINK THAT IN THE MIND OF THE USERS, A REDUCTION IN PRICE IS THE ONLY CONSIDERATION FOR A REDUCTION IN THE LEVEL OF SERVICE? IN YOUR OPINION, IS THERE A LEVEL OF SERVICE THAT IS EXPECTED BY THE USER AND IF SO, AT WHAT PRICE?

I don't know how to answer that question in a general fashion. The

expected level of a future service is first of all thought of in relation to the service perceived today. To me, the idea of perception seems critical. For example, we are so used to an immediate response by pressing an electronic button that the idea of continuity of the electricity service, which is behind that response, is completely foreign to us.

Price is clearly an important factor, but the benchmark is the same: today's price. What counts first and foremost is not the price level, but the price change. The idea of price level linked to service level seems to me to be hard to imagine. The idea of a "market" for services like this, i.e. a change in behaviour in relation to a "price" signal is still (and will remain?) resolutely uncertain.

C- Energy and the user

FROM YOUR POINT OF VIEW, IN TERMS OF INSULATION IN HOMES TO LIMIT ENERGY LOSS, ARE RESIDENT-USERS READY TO INVEST OR DO THEY SYSTEMATICALLY NEED AID, SUPPORT AND/OR FINANCIAL INCENTIVES?

There is a need for support, a need for financial incentives, a need for signals, a need for targeted incentives, large-scale local operations, etc.

HOW ARE USERS REACTING TO THE DEVELOPMENT OF TOOLS FOR MANAGING RESOURCES REMOTELY, SUCH AS REMOTE READERS WITH NEW-GENERATION METERS (WATER, ELECTRICITY, GAS) THAT MAKE IT POSSIBLE TO BILL FOR ACTUAL CONSUMPTION AND TO CARRY OUT SERVICE AND REPAIRS REMOTELY?

I don't have an appropriate response for that question. I am however convinced that these tools have significant potential.

IN YOUR OPINION, ARE PRUDENCE AND THE SEARCH FOR SAVINGS THE RESULT OF A GENUINE WILLINGNESS ON THE PART OF THE USER, RELATED TO AWARENESS OF THE MAJOR ENVIRONMENTAL CHALLENGES SUCH AS CLIMATE CHANGE OR THE REDUCTION IN FOSSILS FUELS? OR IS THIS PRUDENCE ONLY LINKED TO THE CURRENT ECONOMIC CONTEXT FOR THE SOLE PURPOSE OF REDUCING EXPENSES?

It is not just one or the other. It's both. The awareness of the public in general has evolved considerably, but transforming that evolution into long-term behaviour is inconsistent. The gaps associated with socio-economic conditions are significant and the consumerist mandate remains dominant. We are still very far from a consensus that would be based on the rational management of resources. But awareness is greatest among the youngest members of the population.

TOWARDS BETTER GOVERNANCE OF WATER AND SANITATION SERVICES

by Michel RICHARD, User committee for the Grenoble public water service

Beyond individual actions, bringing users together through associations and in Grenoble in particular, as part of the user committee, makes it possible to set up forums for dialogue and consultation. This new governance improves the management of the service and helps it evolve taking into account the needs of users.

Users of a public service are citizens, they therefore have obligations to the community as well as rights.

Let's take the example of the potable water public service: the service regulations dictate the obligations of all users and, when properly set out, remind them of their rights.

However, while water is a public natural resource, which belongs to everyone, its protection, conveyance and distribution generate costs. Today, users have become aware of this fact, but also of the need to use water wisely and to give priority to water for residents rather than for industry or agriculture. The environmental aspect of water management is acquired at the user level.

At the same time, users have become aware that they are, by definition, captive and cannot choose the management method for the service, direct management by the local authority (state control), management agreement with a fully public company (Société publique locale (Local public company) - SPL) or by public service delegation (délégation de service public, DSP) via a semi-public company (société d'économie mixte, SEM) or a network manager (SAUR, VEOLIA, etc.).

The local history of water in Grenoble and certain abnormal practices such as the excessive increase in water prices have led users to come together, to take a stand and to demand to be involved in the management of this public service, so that water is more than simply a good.

In this way, associations of dissatisfied users (Eau secours, *UFC-Que Choisir*, etc.), have become involved in a global discussion on the municipal service by being proactive. From here, a ***specific user committee*** was born.

Its role is to offer an opinion on anything relating to water management, pricing, the protection of the resource and investments. To this end, the local authority and service provider (state control, SPL or delegation) must provide the committee with all the elements required for a full analysis of the dossier put forward. This point is critical, because refusing to provide these elements is the equivalent of considering the user committee as simply a rubber stamp or a political cover, comparable to most advisory committees for local public services (CCSPL), the operation of which is hindered by a legislative and regulatory framework that is somewhat loose. The result is an often minimal application of the legislation, turning this advisory body into a random tool, dependent on political will.

When political and technical mangers supply all these elements for analysis, a climate of trust is created between users and decision makers. This allows users to not only critique but above all to suggest rates, solutions to problems presented, even to intervene to defend the public water service via-vis the competent authorities (prefect, general or regional council president, etc.) in certain specific cases.

For perfect harmony in managing the service, it is beneficial to include the users in the governance plan for the service by having a user committee representative serve on the management entities. Nominating user representatives to the operating board or board of directors of a state controlled body, or as an observer on the board of directors of an SPL or an SEM can only encourage transparency towards users and towards all citizens.

To be independent, the user committee must be made up of representatives from consumer associations, but also representatives from large consumers or institutions such as social housing landlords, the Chamber of Commerce and Industry, the Chamber of Trades. Participation in the committee must also be fully open to being civil, completely voluntary, with no elected officials involved. Elected officials are largely represented on the boards of directors or operational boards of state-controlled bodies, SPLs or SEMs. Likewise, in accordance with legislation, Mayors or Presidents of EPCIs or their representatives preside over the CCSPLs. However, the actual expenses incurred by committee members in carrying out their missions must be reimbursed. To this end, a minimum of material and financial operating resources could be made available to the user committee, allowing it to carry out valuable independent work (room, access to a computer if needed, even access to an expert).

This is the context in which today, in Grenoble, the user committee takes part, in particular, in the working group on establishing the water rate, in the Eau de Grenoble SPL board of directors as an observer, on the operational board of the municipality-controlled potable water body with 2 positions, including vice-president. Each year, the committee gives an advance opinion in writing on the budget, the price of water, as well as on any subject that affects the operation of the public water service.

VIEW FROM LA BASTILLE OVER GRENOBLE G. DUMERY.
Photo: SPL Eau de Grenoble

The most valuable benefit of such an organisation is felt on two levels:

- First of all in the public service to the user, which is managed in a transparent fashion, and the quality of which requires financial resources provided by the price of water, and the benefit and use of which are better understood and adapted in accordance only with the interests of the general public. This organisation requires a significant effort from the manager, but we think that the work generates subsequent savings in processing claims or resolving conflicts because the decisions are no longer concealed or inadequately shared.
- Next, we are convinced that beyond the quality of service, maintaining the public heritage in good condition is ensured in a more sustainable way. The investment options presented by the manager are discussed and the various possible scenarios that require the commitment of future generations cover long periods of time and involve civil society and citizens rather than the term of a mandate or a contract.

For both of these reasons, we are convinced that the operating model we have chosen offers guaranteed sustainability for the user and must be implemented more widely.

Since 1st January 2015, the "water" specialisation had been transferred from the municipalities to the common law metropolitan area of Grenoble in the new governance plan set up under the so-called act on the "Modernisation of Territorial Public Action and the Affirmation of the Metropolis" (Modernisation de l'Action Publique Territoriale et d'Affirmation des Métropoles, MAPTAM). The user committee of the Grenoble public water service must establish its geographic authority and find its role in order to represent and protect consumers, but also work to maintain water quality, discuss the social pricing of water and strive to establish a multi-year investment plan to protect the resource, improve the entire network and its output in order to prevent waste. This can only be done though continuous transparent dialogue with all elected officials, decision makers, and water technicians and managers.

Conclusion

ASTEE was created to support urban engineering, and its 1905 by-laws specified this concept for the first time in France. Today, *"The city needs urban engineering more than ever"* points out Sabine Barles, who also highlights *"the limits of urban metabolism that relies excessively on outsourcing"* and recommends *"a return to metabolism which is more circular and which uses fewer territorial resources"*. Urban engineering which is more attentive to the territories, users and citizens, more respectful of the environment and which is in the process of emerging. While this type of engineering is based on a long history, we need to *"redirect trajectories, organise transitions and not invent the city of the future"*, as part of *"social and technological innovation that combines incremental adaptations and changes"* as we pointed out in the conclusions to the Nantes (2013) and Orléans (2014) publications.

For many years we have been concerned about the collective memory loss in terms of risks, in particular flood risks, in an urban society that is often depicted as removed from reality, to a certain extent living "above the ground" of its own territory. However, Magali Reghezza-Zitt (p.77) shows here that renewing this risk culture is possible. All in all, wouldn't it be better founded on knowledge rather than tradition, and, thanks to greater anticipation and prevention, wouldn't a known risk be more widely accepted? In particular, this is based on the new technologies that provide us with previously unheard of immense real-time data storage and processing capacities.

Making information more accessible helps users to become stakeholders in the evolution of public services, with prices that offer an incentive, show solidarity and are social, highlights Mr. Poujade (p.51): allowing access to individual data, in real time and virtually anywhere, is not a gadget, it's a democratic and transparent management tool. It is not a luxury for geeks, it is a way to increase suitability and efficiency.

In an unfavourable economic context where we often have to do more with less, a new and immense field of study and applications is opening up for municipal services. These services, however, cannot act in isolation and must collaborate with other local stakeholders, as seen at the Nantes conference in 2013, under the title "Urbanism and municipal services, the indispensable alliance".

In 2014, our conference in Orléans showed that innovation only becomes progress when it meets the needs of society. This year's conference in Montauban continues this exchange of ideas by encouraging us once again to place the user and citizen at the heart of our discussions. As Anne Charreyron Perchet writes (p.70) *"cities are created by their own story and by residents with a connection"*. New technologies will help to build a more prudent and protected city, as shown by SEDIF (p.22), if they help make the city easier and more interactive for residents: there can only be a smart city if the users and citizens are smart, whether connected to technology or not.

These three conferences have thus shed light on the various aspects of the major transitions that our territories are experiencing today. On this basis, the next ASTEE conference in 2016 will be devoted to digital intelligence at the heart of our public services. Before being enhanced by technology, this intelligence first and foremost belongs to the stakeholders who, by being attentive and by sharing ideas, have learned how to pave the way for progress: ASTEE's role is give them a voice and to take part in the discussion about these experiences and these projects.

Pierre-Alain Roche, President of ASTEE
and Philippe Marest, Vice-president of ASTEE, manager for local authorities

LIST OF ACRONYMS

- **A21 H25:** Agenda 21 Horizon 2025
- **ADEME :** Agence de l'environnement et de la maîtrise de l'énergie (Agency for the Environment and Energy Management)
- **ADGGC :** Association des directeurs généraux des grandes collectivités (Association of municipal managers from large communities)
- **AFNOR :** Association française de normalisation (French national organisation for standardisation)
- **AMDEC :** Analyse des modes de défaillance, de leurs effets et de leur criticité (FMECA: Failure mode, effects and criticality analysis)
- **AMRAE :** Association pour le management des risques et des assurances de l'entreprise (Association for risk management and business insurances)
- **Anses:** Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail (French Agency for Food, Environmental, and Occupational Health & Safety)
- **ARPE :** Agence régionale pour l'environnement (Regional environmental agency)
- **ARS :** Agence régionale de santé (Regional health agency)
- **ASTEE :** Association scientifique et technique pour l'eau et l'environnement (French Scientific and Technical Association for Water and Environment)
- **BRGM :** Bureau de recherches géologiques et minières (French Geological Survey)
- **CCPS :** Center for chemical process safety
- **CCSPL :** Commission consultative des services publics locaux (local public services advisory commission)
- **CEARC :** Centre européen pour l'arctique (European centre for the Arctic, "Cultures, Environment, Arctic, Representation, Climate")
- **CEREMA :** Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (Centre for research and expertise on risks, environment, mobility and planning)
- **CERTU :** Centre d'études sur les réseaux, les transports, l'urbanisme et les constructions publiques (Centre for studies on networks, transportation, urban planning and public construction)
- **CGDD :** Commissariat général au développement durable (General commission for sustainable development)
- **CLE :** Commission locale de l'eau (Local water commission)
- **CNFPT:** Centre national de la fonction publique territoriale (National Centre of the Territorial Civil Service)
- **CNRS:** Centre national de la recherche scientifique (National Centre for Scientific Research)
- **COP 21:** 21e conférence des parties (21st Conference of the Parties)
- **CRED:** Centre de recherche sur l'épidémiologie des désastres (Centre for Research on the Epidemiology of Disasters)
- **CREMA:** Commission ressources en eau et milieux aquatiques (Water Resources and Aquatic Environments Commission, part of ASTEE)
- **DERU:** Directive cadre relative aux eaux résiduaires urbaines (Framework Directive on Urban Waste Water)
- **DICRIM:** Dossier d'information communal sur les risques majeurs (Municipal dossier on major risks)
- **DRIEE:** Direction régionale et interdépartementale de l'environnement et de l'énergie (Regional and interdepartmental division for energy and the environment)
- **DSP:** Délégation de service public (Public service delegation)

- **ENGEES:** École nationale du génie de l'eau et de l'environnement de Strasbourg (National school for water and environmental engineering, Strasbourg)
- **EPCI:** Établissement public de coopération intercommunale (Public Intermunicipal Cooperation Establishment)
- **EPTB:** Etablissement public territorial de bassin (Public territorial basin establishment)
- **EU:** European Union
- **FEAD:** Fédération européenne des activités de la dépollution et de l'environnement (European Federation of Waste Management and Environmental Services)
- **GES:** Greenhouse gas
- **GIEC:** Groupe d'experts intergouvernemental sur l'évolution du climat (Intergovernmental panel on climate change, IPCC)
- **GTCE:** Gestion technique des consommations énergétiques (Technical management of energy consumption)
- **GTI:** Grès du Trias Inférieur (Lower Triassic sandstone)
- **GWI:** Global Water Intelligence
- **HACCP:** Hazard analysis critical control point
- **ICPE:** Installation classée pour la protection de l'environnement (Facility classified for environmental protection)
- **INET:** Institut national des études territoriales (National Institute of Territorial Studies)
- **Insee:** Institut national de la statistique et des études économiques (National Institute of Statistics and Economic Studies)
- **Irstea:** Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture (National Research Institute of Science and Technology for Environment and Agriculture)
- **LED:** Light-emitting diode
- **MAPTAM act:** Act on the "modernisation de l'action publique territoriale et d'affirmation des métropoles" (modernisation of territorial public action and the affirmation of the metropolis)
- **POPE act:** Programme des orientations de la politique énergétique de la France (Energy Planning Act)
- **LRGP:** Laboratoire réactions et génie des procédés (Laboratory for Reactions and Process Engineering)
- **MEDDE:** Ministère de l'écologie, du développement durable et de l'énergie (Ministry for Ecology, Sustainable Development and Energy)
- **MEEDDM:** Ministère de l'écologie, de l'énergie, du développement durable et de la mer (Ministry for Ecology, Energy, Sustainable Development and the Sea)
- **NTIC:** Nouvelles technologies de l'information et de la communication (New information and communication technologies, NTICs)
- **OCDE:** Organisation for Economic Co-operation and Development (OECD)
- **OMA:** Ordures ménagères et assimilées (household waste and similar)
- **OMS:** World Health Organisation (WHO)
- **ONU:** United Nations (UN)
- **ORSEC:** Organisation de la réponse de sécurité civile (Civil Security Response Organisation)
- **PAPI:** Programme d'action de prévention des inondations (Flood prevention action plan)
- **PLU:** Plan local d'urbanisme (Local urban planning scheme)
- **PPRI:** Plan de prévention du risque inondation (Flood risk prevention plan)
- **PRDE:** Personne responsable de la production et de la distribution d'eau potable (Person in charge of the production and distribution of drinking water)

- **PRERI:** Prévention des risques et protection des prises d'eau de surface de l'agglomération parisienne (Risk prevention and the protection of surface-water intakes in the Paris metropolitan area)
- **REUT:** Réutilisation des eaux usées traitées (Reuse of treated wastewater)
- **RT:** Réglementation thermique (Thermal regulations)
- **SAGE:** Schéma d'aménagement et de gestion des eaux (Water Development and Management Plan)
- **SCOT:** Schéma de cohérence territoriale (Territorial coherence plan)
- **SDAGE:** Schéma directeur d'aménagement et de gestion des eaux (Water development and management master plan)
- **SEDIF:** Syndicat des eaux d'Ile de France (Ile-de-France regional water authority)
- **SEM:** Société d'économie mixte (semi-public company)
- **SIAAP:** Syndicat interdépartemental pour l'assainissement de l'agglomération parisienne (Paris urban area interdepartmental wastewater treatment authority)
- **SIG:** Système d'information géographique (Geographic Information System, GIS)
- **SPL:** Société publique locale (Local public company)
- **STEP:** Station d'épuration des eaux usées (Waste-water treatment plant)
- **UMR GESTE:** Unité mixte de recherche gestion territoriale de l'eau et de l'assainissement (Joint research unit - territorial management of water and sanitation)
- **UMR Icube:** Unité mixte de recherche : laboratoire des sciences de l'ingénieur, de l'informatique et de l'imagerie (Joint research unit: laboratory for engineering, IT and imaging sciences)
- **UNISDR:** United Nations International Strategy for Disaster Reduction
- **UR ETBX:** Unité de recherche environnement, territoires et infrastructures (Unit for research on the environment, territories and infrastructure)
- **UVSQ:** Université de Versailles Saint-Quentin-en-Yvelines
- **ZAC:** Zone d'aménagement concerté (Mixed development zone)
- **ZRE:** Zone de répartition des eaux (Water distrbution zone)

LIST OF PROJECTS, PROGRAMMES, AND INITIATIVES

NOTES

PRUDENT AND PROTECTED TOWNS AND TERRITORIES

How municipal services rise to the challenge

Introductory work

The theme of ASTEE's 2015 conference in Montauban is the prudence and protection of municipal services. To address challenges in terms of demographics and climate, we will need to manage the resources necessary for human life and for the operation of our cities. We will also need to anticipate natural and man-made risks that could render city life impossible. How can municipal services make cities more prudent and protected? Can they all do so to the same degree and can they do it at the same time? These questions are the focus of the contributions put together in this report. Here you will find, as a preview to the Conference itself and in order to explain the primary issues, discussions, points of view, testimonials and feedback from elected officials, from researchers, from operators and experts on the city and its services. The report outlines a "road map" showing how municipal services and support and reinforce the municipal policies of prudence and protection, against the backdrop of climate change yet to come.

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