

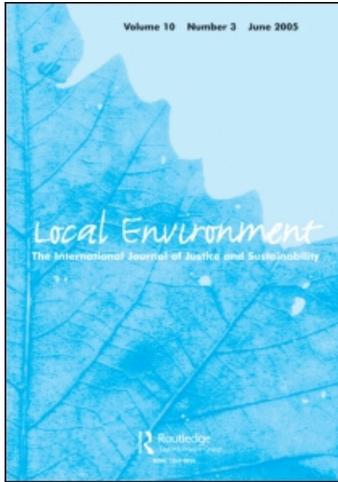
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From the sanitary city to the sustainable city: challenges to institutionalising biogenic (nature's services) infrastructure

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Much has been made of the need for cities to become more sustainable, particularly since for the first time in human history over half of the world's population are urban dwellers. Cities concentrate human activities in an exceptionally powerful manner, and this includes resource use and the generation of pollution. Attention has turned towards cities for their capacity to enhance and use nature's services – ecological sustainability – to remediate some of their own environmental impacts. Insufficient attention has been paid to the challenges of implementation of this new approach to infrastructure in an era of devolution and skepticism about government. This paper discusses these twin and interwoven questions through the lens of an on-going natural experiment, the implementation of a million tree-planting campaign in Los Angeles, CA.

Keywords: infrastructure; governance; sustainability; nature's services; implementation

Introduction

Much has been made of the need for cities to become more sustainable, particularly since for the first time in human history over half of the world's population are urban dwellers. Cities concentrate human activities, and this includes resource use and the generation of pollution. With increasing concern about climate change, attention has turned towards cities for their capacity to enhance and use nature's services – ecological sustainability – to remediate some of their own environmental impacts (Alberti and Susskind 1996, Rees and Wackernagel 1996, Alberti, 2008). Little thought, however, has been given to what this new approach may imply for the ways in which cities are managed and funded, including the organisation of existing departments and agencies, urban morphology and land use, public interest, acceptance and participation, and potential unanticipated consequences. This article arises from a National Science Foundation-funded study of the implementation of a million-tree planting programme in the city of Los Angeles. Our team consists of an urban planner, a plant ecologist, an economist and a physicist conducting remote sensing of Earth systems, including carbon sequestration and land-use change.

Mayor Villaraigosa of the city of Los Angeles made an ambitious campaign promise: to make Los Angeles the greenest city in the USA. To do so, among other initiatives, he promised to plant a million new trees. Mayor Villaraigosa is not alone. Mayor Bloomberg of

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New York is also promising to plant a million more trees in New York, and cities across the country are embarking on campaigns to add to their existing tree canopy to improve the environment. These initiatives could be written off as campaign promises, but their popularity, and the emerging science quantifying the benefits of urban trees, suggest there is more going on (USDA, Northern Research Station 2008 for extensive bibliographies on tree benefit research www.nrs.fs.fed.us/pubs/). For example, Washington DC's urban forest is estimated to store about 526,000 tons of carbon, and to remove about 540 tons of air pollution a year (Nowak *et al.* 2006a); the urban forest in Casper Wyoming is estimated to store about 37,000 tons of carbon and to remove about 50 tons of air pollution per year (Nowak *et al.* 2006b). McPherson *et al.* (2008), estimated that a million more trees in Los Angeles could, per tree, intercept from 102 gallons annually to a high of 1481 gallons a year, based on the tree size, rainfall amount, and foliage period. Over the 35-year life span of the million tree project, there could be a reduction of runoff by 13.5–21.3 billion gallons. Energy use reduction was projected to range from 718,671 to 1.1 million MWh and atmospheric carbon dioxide reduction over the 35-year planning horizon could range from 764,000 to 1.27 million tons over the same 35-year period. A million more trees in Los Angeles could also improve human health and environmental quality through the interception of small particulate matter (1,846 to 2,886 tons from power plants), the uptake of ozone (2430–3813 tons) and nitrogen dioxide (1949–3039 tons) (McPherson *et al.* 2008, pp. 5–6). Such ecological services situated in the city itself, are seen to help mitigate the negative environmental impacts generated in that place.

This paper posits that the shift from today's enduring progressive era sanitary city model (or the modernist city) to a sustainable city model will not only entail physical infrastructure accommodations, but will require substantial changes as to how cities are governed, raising questions about funding, legitimacy, transparency, and equity. Sustainability includes, and is not limited to, urban-tree planting, watershed restoration and green streets programmes to capture stormwater and dry weather runoff through techniques such as bioswales and water infiltration zones.

While there has been attention given to the need for cities to become more sustainable (Beatley 2000, Ravetz 2000, Satterthwaite 2001, Haughton and Hunter 2003, Portney 2003), as Bulkeley and Betsill (2005) point out, the propensity for analyses of urban sustainability to focus on techno-centric models and wish-lists of measures that should be introduced has meant that other critical questions have been neglected (p. 43). For example, little has been written about how a paradigm shift to sustainability interacts with the governmental and fiscal context in which such initiatives are taking place, nor what kinds of administrative regimes need to be created for biogenic infrastructure. Engagement with the impacts on local populations and changes in behaviour that might be required is scarce, as well as analysis of potential costs to residents in time and in resources. Infrastructure – whether biogenic or not – must be financed, managed and maintained, and biogenic infrastructure (because it is alive) requires more diffuse and daily maintenance than traditional grey infrastructure of pipes, wires, and machines that tend to be centralised and streamlined.

My approach in this exploratory essay is to use a specific example – the million tree-planting initiative of the city of Los Angeles – to raise a class of issues about the implementation of green, sustainable infrastructure that go beyond Los Angeles. I attempt to show that urban environmental management in the USA has a set of institutional contexts, and a path dependency (North 1990) that shapes current debates, expectations, and patterns. I will then address the emergence of sustainability and governance approaches to the environment, and the tensions they create with current city organisational structure for democratic accountability and participation, and for equity.

The emergence of sustainability and governance are the outcomes of processes that have occurred over time: sustainability comes as a response to the perceived degradation of the environment by human action, and governance as an approach to managing human affairs comes out of complex changes in the economy, attitudes towards the state, and global geopolitical shifts (Jordon 2008). Nature's services infrastructure therefore finds itself nested in a whole set of political and economic shifts towards governance, a secular shift in state-market-society relations that implies that important new economic and social conditions and attendant problems have emerged which cannot be managed or resolved readily (Jessop 1998, p. 32).

The creation of the modern sanitary city¹

By the end of the nineteenth century, the impacts of rapid industrialisation and population growth on cities were harmful to human health and well being, and for local environments. Now classic works starting with Engels' *Condition of the Working Class in England* (1844) to Jacob Riis *How the Other Half Lives* (1890) and Upton Sinclair's novels, drew attention to the egregious circumstances of working people's daily lives, corruption and lack of regulation. Excesses fostered an age of reform that lasted nearly 30 years: the Progressive Era (Hays 1959, Weibe 1967, Pincetl, 1999). The Progressive Era is applied to a set of broad and somewhat disparate social and economic reforms, as well as significant governmental reforms. These included the institution of a professional, disinterested hierarchical government administrative structure organised to best facilitate efficiency and economic growth, and better working and living conditions for the less fortunate – such as the eight-hour day. At the local level, Progressives introduced modern management to cities, including formal departments, agencies, responsibilities and procedures and scientific expertise to resolve serious sanitation problems. Progressivism, it could be argued, was the political and institutional application of the emerging ideology of modernism, wherein efficiency and comprehensive planning could indeed be implemented through the right configuration of institutions.

The edifice of modern city management was constructed during this period. In 1899 in the USA, the National Municipal League promulgated a model city charter, including expanded home rule, a stronger mayor and council, trained administrators and an emphasis on qualified personnel selected by civil service, bringing many classes of "experts" into municipal government (Scott 1969, pp. 41–42). Governmental budgeting and accounting practices were changed so that costs could be clearly associated with specific activities of government; allocation and accountability performance measures were introduced, making reports comparable between communities among other budgeting reforms (Williams 2002, p. 458). Civil service procedures were adopted by municipal governments by 1935 (Tolbert and Zucker 1983) resulting in professional civil service cadre of trained professionals becoming the norm in city bureaucracies. These included planners, civil engineers, traffic engineers, and sanitation specialists of many types. Bacteriology and civil engineering were applied to the urban fabric, bringing citywide distribution of fresh water after being treated in purification plants, sewage systems were built to take wastewater out of neighbourhoods to treatment plants. "The newly emerging profession of civil engineering played a dominant role in promoting and implementing environmental sanitation programmes and developing the new technologies of sanitation" (Melosi 2000, p. 69). By 1935, the transformation of a city government from a politically based system to a science-based, bureaucratic-based system was well underway (Hays 1972, p. 9).

Graham and Marvin (2001) point out how the sanitary city was constructed over a century into the modern networked city. Standardised roads, water systems, waste

removal and treatment, energy provision and communications as single, integrated and standardised systems covering municipalities, cities, regions, and even nations were part of the modern idea of progress (Graham and Marvin 2001, p. 41). In fact, the dominant characteristic of the modern city is its networked character (10). These technological networks of water, gas, electricity, information, are the mediators through which the perpetual process of the transformation of nature into city takes place (Kaika and Swyngedouw 2000, p. 1, in Graham and Marvin 2001, p. 10). Further, infrastructural networks have traditionally been central to the normative aspirations of planners, reformers and social activists to define their notion of the good city (Friedmann 2000, in Graham and Marvin 2001, p. 12). The modern networked city had a universalising discourse, in which all spaces were to be integrated by ubiquitous, democratically accessible and homogeneous infrastructure grids, usually under public ownership, even if violated in practice. The networks were quasi-public, goods to be consumed by all, at similar generalised tariffs, guided by the principles of non-excludability and non-ejectability (Graham and Marvin 2001, pp. 102, 80).

Clearly all of the specific details of the formalisation and implementation of federal, state, and local governmental organisation are beyond the scope of this paper. There were multiple, interconnected, and interdependent strands that contributed to making the rule-bound, legalistic and formal governmental structures we have today. The city services we are concerned about – water supply, sewage sanitation, street maintenance, and so forth – are now provided by trained professionals whose professional societies, such as the American Society of Civil Engineers or the National Water Quality Association, play important roles in developing standards and certifying their members. Each of these specialties – sanitation, street services, planning – works in a bounded realm informed by specialised competences siloed into departments and agencies. They operate from a general framework of rational comprehensive planning of large-scale infrastructure. The Progressive Era established the foundation of legitimacy for state-led solutions in infrastructure provision and governmental authority and this approach was carried out through the 1960s–1970s, driven by public funding and commitment to creating efficient and sanitary cities.

Disillusionment with the modernist project has grown as it has not been able to keep up with increasing population growth, infrastructure demand and the complexity of technology and the economy. Tax revolts of the late twentieth century in the USA and especially in California, skepticism about the role and ability of government to plan have led to more of a project-by-project approach and a pragmatic attempt to address perceived local problems rather than a utopian or visionary framework for re-engineering metropolitan areas (Graham and Marvin 2001, p. 103). Fragmentation, or unbundling of networks has also occurred. Undermined by critiques from both the left and economic liberals, overtaken by the rapidity of technological change, especially in information technologies, the traditional systems of government-led infrastructure provision have faltered, though still lies within the mission statements and responsibilities of most local public agencies. The competent delivery of these systems also remains in the expectations of urban residents – cities should deliver clean water, electricity, access to open space, healthy neighbourhoods, sewage treatment, and other infrastructure amenities of modern living. Municipalities are also often legally required to do so as well. Thus, in the early twenty-first century, local municipalities still carry the burden of performance of the modernist era, but without the capacity – whether monetary, or of legitimacy.

Sustainability and governance

Environmentalism of the past quarter century then drew attention to the quality of the environment: air pollution, water pollution, toxic substances, and now greenhouse gas

emissions. The problems had changed from cholera and polio, to particulates, volatile organic compounds, and other kinds of chemical pollution concentrated in urban environments, affecting people and health of the ecosystem. Many of these pollutants are highly concentrated in cities which are among the most profoundly altered and managed ecosystems on the planet (Collins *et al.* 2000). Not only are humans for the first time ever predominantly urban dwellers, but it is increasingly evident that urban areas are the biggest generators of global environmental pollution and greenhouse gases, grave threats to life as we know it. Environmental rules and regulations were added to the responsibilities (and costs) of governments, and of localities.

Sustainability has been one of the responses, adding to the pollution control technology regulatory strategy. While the core meaning of sustainable development remains messy, (Jordon 2008, p. 28) at an urban scale there are strategies that are generally recognised as sustainable. Nature's services fall under that definition, in addition to green building, renewable energy and so forth.

Urban sustainability: the integration of nature's services in city departments

I define nature's services following the Millennium Ecosystem Assessment (2005): ecosystem services are the benefits to humans provided by ecosystems. They provide *provisioning* services such as food and water, *regulating* services such as climate, floods and water quality, *cultural* services such as recreation and aesthetic enjoyment, and *supporting* services such as soil formation, pollination, and nutrient cycling (p. 39).

Natural processes persist in our anthropomorphic urban environments, but since the advent of the industrial sanitary city and population growth they are highly manipulated and often impaired. With the understanding of the importance of cities as the new home of human kind, the ecological role of urban areas is now seen as potentially transformative. An aspect of this potential involves how and where urban areas can remedy their own negative externalities through nature's services-based integrated infrastructure.

Daily (1997) and Robert Costanza's pioneering work on the value of nature's services have inspired a consideration of the importance of nature's processes for human survival (Costanza 2006, 2008, among many articles and books). Earlier ecologists and urbanists had also drawn attention to nature in the city and the powerful ways it could be worked with, rather than ignored or hidden, but the historical time was not propitious for the integration of their observations (McHarg 1971, Spirn 1984, Hough 1995). More recently, the rise of the concept of nature's services has resulted in studies estimating of the value of services such as trees in the city for human benefit. However, to institute such nature's services infrastructure is challenging as biogenic infrastructure must be designed correctly to provide the desired services. Nature's services infrastructure needs to be placed at optimal locations, properly sized, and not too diffuse in geographical extent to make a difference.

Nature's services infrastructure also suggests coordination and cooperation among traditionally separate departments such as planning, transportation, sanitation and other utility providers, and new biological knowledge about soils and microbes and their pollution filtration potential, which trees are the most appropriate for bioregion, climate, and desired function. Finally, unlike grey infrastructure that is generally hidden underground, in pipes, or else made inaccessible in concentrated facilities, nature's services infrastructure is in plain sight, it takes up real physical space, and if it is not regularly maintained, (gardened) it will look unattractive, may not work and/or it will die. This implies a different knowledge and maintenance regime from the networked modern city to one more akin to parks. As nature's services infrastructure will need to be geographically distributed

throughout the city, at low but extensive intensities. It is likely to be an expensive proposition for cities themselves to maintain with traditional means, including siloed civil service employees and rules. To implement nature's services infrastructure in a different way, for example, in an interdisciplinary/interdepartmental way, would require quite a few fundamental changes in city personnel, budgeting, administrative organisation, and land use. To date, many cities have contracted with non-profit organisations to implement this infrastructure sprinkling nature's services onto the existing urban landscape where opportunities arise, and opposition is low through tree planting, stream daylighting, or watershed restoration – a far cry from the implementation of an integrated ecosystem services infrastructure.

Nature's services infrastructure butts up against the epistemological structuring of disciplines reflected in city agencies that is based on divergent and exclusive framings of each subject and distinctive methods of inquiry and problem solving: meeting stormwater runoff requirements, for example, is an entirely separate function from providing clean drinking water, though they could be united under a common agency that ensures that stormwater is not wasted and becomes integrated into water supply (Petts *et al.* 2008). Nature's services infrastructure also has multiple distributed benefits. Urban forests, for example, are alleged to cool the urban environment (reducing energy use), encourage walking (improving public health), mitigate storm water (relieving flooding and storm water purification costs), and more. Yet in today's hierarchically and vertically organised city, one department will be responsible for the forest and incur all the costs. There is no way to account for the multiple benefits, nor any cost sharing among agencies that might obtain a benefit through avoided costs (such as less hospital visits, providing less electricity for cooling in the summer months) (Pincetl 2007). Finally, nature's services infrastructure impact residents – tree limbs may fall on parked vehicles or roots may infiltrate sewer pipes, trees drop their leaves and need to be picked up, and trees need irrigation in drier climates. All of these costs are borne by the individual residents.

Government to governance

Governance is a somewhat blanket term that redefines the extent and form of public intervention and the use of markets and collaborations to deliver public services (Rhodes 1996). The concept has emerged in past two decades due to a shift in confidence away from the effectiveness of governmental programmes that have been portrayed as tightly structured hierarchies insulated from market forces and effective citizen pressure, free to serve the personal and institutional interests of bureaucrats (Salamon 2002, Fiorino 2006). Pierre and Peters (2000) trace the shift from a government to governance in the twentieth century with the Thatcher and Reagan eras in Britain and the USA. Previously government was the appropriate, legitimate and unchallenged vehicle for social change, equality and economic development, and it was responsible for environmental protection, public services and welfare (p. 2) (Graham and Marvin (2001) rightly point out that this is an idealist view as the government was challenged by social movements). The state has been losing its steering ability as control is displaced upwards to regional and international organisations, downwards to regions and devolved localities, and outwards to non-governmental organisations and other private or quasi-private bodies (Peters 2000, pp. 83–91 in Jordon *et al.* 2005, p. 480). In the case of municipalities there is increasing reliance on non-governmental organisations and other private or quasi-private bodies, such as Business Improvement Districts and non-profit organisations to provide services, including implementing nature's services infrastructure.

Mouffe points out that governance, unlike government, refers to policies rather than politics because it is not a binding decision-making structure (Mouffe 2005, p. 103, in Krueger and Gibbs 2007, p. 30). Governance is a stakeholder-based arrangement in which traditional state forms partake with experts, NGO, and other responsible partners (Krueger and Gibbs 2007), but the involvement of the resident is often ignored. Residents, though they may be impacted in unprecedented ways by nature's services infrastructure, are rarely the topic of analysis and discussion. Rather, non-profits are often treated as their proxies, and further, there is a patronizing attitude towards residents. They will benefit from the enhancement of these services in their neighbourhoods – greater tree canopy cover, better healthy of communities with the restoration of watershed functions in absorbing water pollution, whether they realise it or not (Platt *et al.* 2008, in Birch and Wachter 2008). Watershed restoration associations, tree planting groups, even citizen activists in urban infrastructure development remain defined and organised as stakeholder or interest groups. While some believe that there are many individuals interested in volunteering to reduce demands of large-scale infrastructure in their communities and in adopting ways of life that reduce energy and water consumption that have been reached (Wiland and Bell 2006), this phenomena is not well studied. Efforts to reduce water consumption in Los Angeles show that people can be appealed to successfully, and there are many similar examples of success across the country. But whether this leads to fundamental behavioural change over the long term is not known.

The fiscal crisis of the state, the rise of the use of NGOs

The shift in confidence away from government has been accompanied by a reduction of funding for many levels of state government. Tax cuts, exemplified by California's Proposition 13 slashing property taxes and requirements for second or third majority votes for new local taxes, both passed through ballot initiatives, have reduced the margin of manoeuvre of the government. At the state level, the annual state budget must also be approved by a two-thirds majority vote. The result for Los Angeles, for example, has been a budget decline of an average of 4.73% *per capita* since 1968 for Urban Forestry despite an increase in population of about a million people (Los Angeles Almanac 2000). The budget of Department of Recreation and Parks over the same period, increased a little over 1% *per capita* (Chief Legislative Analyst Budgets). Urban Forestry, despite the Million Tree programme has had no additional funds to plant more trees (Gonzales 2007). Such budget limitations affect the ability of city departments to expand services. The current Los Angeles budget has been reduced from this period. The Bureau of Street Services where Urban Forestry lies has received a 13.6% cut, the Environmental Affairs Department a 13.0% cut, the Planning Department a 22.4% cut (<http://budget.lacity.org/>). In the best of times, to achieve the goal of planting more trees, the city would have to cobble together many sources of funding and enlist non-governmental actors, including homeowners and non-profit organisations, to co-produce the urban forest. This has become even more urgent in the current circumstances.

Swyngedouw (2005) has described governance as the emergence of institutional arrangements of "governing" which give a much greater role in policy-making administration and implementation to private economic actors and parts of civil society in self-managing what was recently provided or organised by the national or local state. Stoker (1994) writes "governance is the acceptable face of sending cuts". Such governance is prevalent in the provision of open space/park/nature's services. Svendsen and Campbell (2008) in a recent assessment found more than 1000 active park-based stewardship groups

and over 600 community gardens in New York City. Active organisations participate in the delivery of public programmes as well as daily maintenance and fundraising support for environmental stewardship, taking a significant responsibility for a wide range of land-use types, including street and riparian corridors, vacant lots, public parks and gardens etc. Such activities, they write, have blurred the hard boundaries of public entities and civil society at the local level. They acknowledge that New York City has more of these types of organisations than in the other cities they studied. Los Angeles itself also has numbers of non-profit organisations active in environmental stewardship, though no systematic study has been undertaken of these groups. And in Los Angeles too, the boundaries of public entities and civil society are blurred, and the Million Tree Initiative is a prime example of this shift.

Million Trees Los Angeles

Over the course of almost three years, researchers interviewed about 20 people involved in the Million Tree Initiative. Researchers also monitored local press reports, conducted literature surveys, participated in tree give-away and planting events associated with the programme and collected information about tree-planting programmes across the country. In addition, we studied water use by trees in the city and the effect of trees on the city's urban heat island over 30 years. Results from these investigations point to complexities not only in implementing such an ambitious programme, but also in the environmental impacts of trees in the urban environment. While trees have been found generally to reduce the urban heat island effect, they have also use a great deal of water, do not consistently improve property values, and are not uniformly embraced (Pincetl submitted). Planting an additional infrastructure is multi-faceted. The *implementation* of the programme is our focus here, though it touches on all the other issues as it is being implemented in the belief that trees have positive multiple environmental and social benefits.

Mayoral candidate Villaraigosa's 2004 campaign promise to plant a million trees was one of several programmes he put forward to make Los Angeles the greenest big city in the USA. One of his close political advisors explained that it was proposed to Villaraigosa by a campaign advisor and it seemed like a great idea at the time (Swiller 2007). The implementation was seen as relatively straight-forward and unproblematic (Swiller 2007, Freeman 2009).

First located in the Department of Public Works, the programme had a rocky start. The Public Works Commissioner put in charge launched an ambitious planning effort for the programme, bringing together the main tree-planting non-profit organisations of the city, city departments from planning to urban forestry, consultants and academics (the author was among the group). A plan was established, many issues were discussed from climate appropriate tree selection, working with the nursery industry to increase the availability of such trees, interagency collaborations and more. The Commissioner jawboned the non-profits to agree to plant trees in assigned council districts (one non-profit refused and its participation is limited to planting trees in parks exclusively) and the programme was launched (Daniels 2007). With no funds available from the city's budget for the city to plant the trees itself, non-profit organisations assumed the major responsibility for planting the trees with assurances – as each of the consecutive Million Tree Programme Directors confirmed – they would be recompensed through funds raised by the Mayor from the private sector (Daniels 2007, Morris 2007, Sarno 2007).

Nine months later the Mayor had raised no money for the programme, tree planting non-profits had participated in several Million Tree Initiative launch events, incurred staff costs, and were beginning to express their unhappiness with the programme; they had not been paid, and the Commissioner was in an awkward position since she had depended on the Mayor to follow through on his promise to raise the necessary funds (Daniels 2007). There were other problems too. Trees being offered to the public included spindly one-gallon seedlings and rumours abounded about these trees ending up on people's balconies but counting toward the million mark, all of which provided fodder for critical articles that began appearing in the press. The Mayor's office, sensitive to negative press, acted swiftly and shifted the programme out of the Public Works Department out from under the Commissioner and gave it to another person, whose status was ambiguous. She was in Public Works, but under contract and also in the Mayor's office, given even less resources and direction, and lasted only a couple of months (Morris 2007). It was then sequestered in the Mayor's office where a trusted political operative of the Mayor was put in charge of the programme, where it still is as of this writing. Much of the initial planning work was set aside, work on tree species and targeting locations was shelved, and the new Director of the programme engaged each tree planting non-profit individually about their participation, holding no coordinating meetings, nor developing an alternative implementation plan. Additional tree plantings, outside the Council Districts farmed out to the non-profits, were targeted on an opportunistic basis, for example, in planting strips near schools in areas of the city with low canopy cover (Sarno 2008).

Today there is no plan guiding the tree planting, and there is little public information available about the programme, including the budget and sources of funding, numbers of trees planted, locations, and species of trees chosen. Many of the links on the city's Million Tree Los Angeles website are inactive (www.milliontreesla.org).

Million Trees Los Angeles (MTLA) engages five different NGOs to plant trees. Four of the NGOs area assigned Council Districts within which they are to plant. Tree sizes, species and the tree itself are determined by MTLA. MTLA's Director fundraises for the programme and the local utility – the Department of Water and Power – provides the trees, but the NGOs must also raise their own funds for the programme from state, federal and Foundation sources. It is a highly competitive terrain among the NGOs, for funds are scarce. Characteristically, employees are paid NGO wages and there is no job security. Questions of organisational capacity, funding, staffing often outpace the political power or organisational capacity of any single NGO (Bullard 1990, in Bure 2007, Romano 2007, Svendsen and Campbell 2008). Management of the tree planting NGOs by the city is done behind closed doors and often organisation-by-organisation, so there is little or no transparency relative to the delegation of tasks, or funding, and dialogue among the NGOs is rare and often contentious (Bure 2007, Romano 2007, Smith 2007). Further, since there is no public plan for the Million Tree Program there is no ability for residents to know what is being envisaged relative to this new infrastructure. Million Trees is opaque and mysterious with its decentralised implementation to multiple public-private partnerships and the city can only exercise "loose leverage" (Kettl 1993).

The non-profit tree planting organisations in Los Angeles – hired to bring greater nature's services to communities that have less trees than more affluent areas – find real resistance. Residents in areas of high crime in the city often do not want street trees planted in front of their properties, or more trees at all since they fear that criminals will be able to hide in the trees (Bartlett 2007, Bure 2007, Sarno 2008). Furthermore, not only do some residents consider trees a potential crime danger, but there are residents who do not like trees, nor do they do not wish to assume the additional water costs for

irrigation, and potentially end up paying if the tree roots damage sewage lines (the NGOs must have a resident's accord to plant a tree in the planting strip in front of a house or apartment building and that agreement comes with an obligation to maintain the tree for 3 years). They may also not want the shading effect of trees on their existing landscaping. These concerns illustrate the ways in which a nature's services approach can affect residents. While grey infrastructure is also costly, it is generally invisible and does not require maintenance by city residents. Contrary to the modern city, the sustainable city will be far messier and less sanitised. Vegetation will be climate appropriate, so in places like southern California, this may mean summer dormancy – in other words brown untidy plants rather than clean green lawns. The land uses of horizontal suburban cities, to accomplish the ends of a nature's services infrastructure, will have to devolve away from impermeable hard surfaces devoted to the automobile to shared spaces for plants, insects and microbiota; an evolution into a very different looking landscape, and a different management regime. Yet the governance aspect of this new use of the public commons for ecosystem services for urban infrastructure is both part of and different from the modernist paradigm. It fundamentally believes that good science and information will yield better results – a modern, progressive view – and at the same time it questions the dominant structure of knowledge and organisational form of cities.

The contradictions of governance

Non-profit organisations have become nature's services amenity providers as the fiscal ability to provide infrastructure, including parks and the new green infrastructure, has shrunk in many cities as a result of the decline of revenues (Pincetl 2003, Svendsen and Campbell 2008). These civil society organisations themselves may or may not genuinely reflect, or engage with, grassroots civil society power, but are often the *de facto* interface with state power. As Swyngedouw (2005) and others have pointed out (Jessop 2003, Hajer 2003) public private partnerships that involve governance arrangements seem to offer the promise of greater democracy and grassroots empowerment, but they may also exhibit a series of contradictory tendencies (Swyngedouw 2005). They reflect a state government that has had to reorganise and to mobilise a new set of “technologies of governing” to respond to changing socio-economic and cultural conditions (Swyngedouw 2005) with. “[N]o clear rules and norms according to which politics is to be conducted and policy measures are to be agreed upon” (Hajer 2003, in Swyngedouw 2005, p. 1992). Further nature's services infrastructure is a physical thing, it takes space in neighbourhoods and changes and impacts existing land uses. Nature's services infrastructure impacts people's daily lives and property. Its health and maintenance of this infrastructure requires a new approach to urban land use and zoning in which public space is appropriated for ecosystem services (rather than the car), including shared streets with increased room for plants, bios-wales and water filtration, greened alleyways, greater room for street trees narrowing streets, and dedicated storm water infiltration areas' grey water treatment areas. It may also include new rules about private land use too in order to enlist as much of the city's unbuilt spaces as possible to provide the services of ecosystems. Ecosystem services infrastructure are land intensive and the services do not stop at the line between private and public property.

All of this does suggest a new management model for the city in which the role of the state is more coordinative utilising a fusion of public and private resources and individual property owners (Evans 1997, and Payne 2000, in Pierre and Peters 2000, p. 25). Nature's services draws on more communitarian views of the organisation of society wherein not only do ecosystem services in urban areas help mitigate the impacts of cities broadly, but the

place-specific addition of these services improve people's quality-of-life and health – street trees encourage pedestrian activity, reducing obesity while also serving to cool the urban heat island effect, mitigate storm water flows and so forth. Hence, there is a kind of assumption that nature's services infrastructure is a public good that the public, from the bottom up, will assist in implementing, including through NGOs. As the Million Trees Initiative in Los Angeles shows, the implementation of this new approach is not so smooth.

Discussion: the underside of urban sustainability

This paper has examined the complexities and contradictions of implementing nature's services for greater urban sustainability. The shift to governance – public–private partnerships, co-production and management of services, coordinated by government – comes about as a reaction to the perceived failures of the Keynesian state. As Kettl (2000) writes “. . . the challenge is reconciling the management and accountability challenges of these new networks [of non-governmental partners in service provision] with the bedrock that hierarchical authority has long provided. How can government ensure accountability in extended service networks where implementation responsibility is widely shared and where no one is truly in charge? How can government, structured and staffed for an era when vertical relationships dominated, build the capacity to manage horizontal partnerships effectively?”(p. 494).

At the same time, as Lemke writes, “[W]hat we observe today is not a diminishment or reduction in state sovereignty and planning capacities, but a displacement from formal to informal techniques of government and the appearance of new actors on the scene of government (e.g., NGOs), that indicate fundamental transformations in statehood and a renewed relation between state and civil society actors” (Lemke 2002, p. 50, in Swynge-douw 2005, p. 1997). The displacement focuses attention on the service provider – the NGO – and not the city itself that is piloting the programme behind the scenes. Bakker (2002) aptly describes this as a process of re-regulation characterised by an emergent new form of governance and of resource allocation. In the Los Angeles instance, power is concentrated in the Mayor's office, and there is little or no transparency about the goals, ends and plans of the programme for either the non-profit partners or the target communities. Rather, the city directs the programme according to its own internal logic, but through the NGOs. In contrast, if the programme had been implemented by the Urban Forestry Division of the Bureau of Street Services, public consultation would have been obligatory due to administrative rules guiding city procedures. If the city had implemented the programme it would have fallen within the rules of the modernist city of public disclosure of a plan, comments on the plan, and possible modifications of the plan. Instead, the programme is relying on an opaque mixture of public and private funds funnelled to an unaccountable non-profit organisations for the programme.

The use of NGOs to implement programmes in cities cannot afford to implement themselves is a form of outsourcing and allows the avoidance of public involvement and scrutiny that would be required under entirely, city-funded and implemented planning and implementation. The gradual substitution of the use of non-profit organisations to provide services (Wolch 1990, Kodras 1997, Lake 1997, Trudeau 2008) requires theory that can appreciate the variegated interactions that take place between state and non-state actors to form hybrid public/private relationships that have multiple facets. One thing is for sure, there is no going back to the modernist city where the state is wholly responsible for service and infrastructure provision. Trudeau (2008) observes that NGOs have multiple and diverse roles in places – there is a continuum of possible relationships that they can form with government and that NGOs too have multiple constituencies to whom they are

accountable. Still the use and integration of NGOs in service provision, the forms of governance and co-production programmes take, are both emergent and require greater understanding. For the implementation of nature's services ecosystems that affect people's properties the relationship of the city, the NGO and the property owner is particularly tricky.

Thus, the *implementation* of a decentralised green infrastructure – if indeed this is one of the key elements for greater urban sustainability – remains unproblematised. With the Sanitary modern City came city-provided services. With the hollowing out of the state has come governance and the contracting out of services to non-profit organisations. For ecosystem services-based sustainability, there is yet no well-articulated management architecture, but a great deal of faith in the approach. Unlike the modernist city's infrastructure of water purification and delivery systems, of sewage sanitation plants, roads and freeways, and communications networks, the sustainable city's green alternative is largely one built on sentiment and common sense, but little scientific knowledge and even less engagement with how the organisational constraints of current land use and urban governmental structure, funding, rules, regulations and mandates may need to be changed. Moreover, as an article of faith, implemented outside of traditional processes of hearings and plans, there is no place for communities to comment about the changes.

Shifts in the implementation of service delivery of public goods (like nature's services-based infrastructure) to semi-public and private governance – contracting out tree planting to several autonomous non-profit organisations – alters established systems of accountability that people understand and know. Networked approaches make it less easy to locate loci of power, to identify where decisions are being taken and who is responsible. Important questions emerging from governance arrangements, as VanKersbergen and Van Waarden (2004) point out, are those of governability, accountability, and legitimacy. Governance, as Hirst (2000) points out, has a post-political thrust that evades the issues of democracy and political conflict (p. 33).

At the same time, as Graham and Marvin (2001) note, one should not also romanticise the modernist project. Its fall is in part due to the strength of social movements that arose out of oppression and exploitation for wealthier and more powerful interests. It could be argued that, in the USA, the modernist sanitary city governmental system installed procedural and not substantive democracy. People could – and can – participate in public hearings and have access to public records, but decisions get made that override their objections all the time. Still, the rise of governance complexifies processes and the readability of urban systems. It creates parallel power centres and interests that balkanise the relationships between state, non-governmental entities and areas in the city. What wealthy neighbourhoods may want and desire – more trees and nature's services – may be a burden to less advantaged parts of the city.

Conclusion

The transition from the progressive era sanitary city to the sustainable city is complex, multi-layered and messy. While the environmental benefits of nature's services in cities have started to be quantified by biophysical scientists, little critical analysis has yet been conducted on the implementation of this new and different type of infrastructure.

Areas for further research include:

- What are the ideas of nature guiding the urban use of ecological services?
- If, as Kaika and Swyngedouw (2000) state, the modernist city transformed nature into a city through technical networks, is the sustainable city Richard White's *organic machine* (White 1995) – city transformed into nature?

- What are the actual biophysical effects of implementing ecological services infrastructure in urban places and spaces (tree planting, watershed restoration, bioswales, infiltration trenches and so forth)?
- What science is necessary to understand the actual biophysical effects of these services?
- How much “naturalisation” is necessary to produce measureable effects, if any?
- What are the new forms of municipal government necessary to implement the sustainable city?
- Are partnerships necessary, and what kinds?
- What are the impacts on land use in the city, on public and private spaces?
- What are the costs of ecosystem services infrastructure?
- What are the possible sources of funding for such an infrastructure?
- How does an ecosystem services-based infrastructure interface with the post-modernist splintering city, e.g., does it contribute to exacerbate inequalities and left aside places?
- What are the aesthetic/image implications of moving from invisible technical systems to living, Earth-based systems in the urban environment?

Human’s relationships to nature are deeply and subtly shaped by culture, including technology, science, history, and economy. In the aftermath of the disillusionment with the modernist city, the rise of the environmental movement and the understanding that Earth systems are being altered by human activity, it is almost paradoxical that cities have been discovered by biophysical scientists and others for their role as sources of air and water pollution and as potential sites of remediation. Doing so through using nature itself has become a popular notion, inspiring programmes such as planting the urban forest. This approach represents a sea change relative to the city which has been seen as a place to escape from in order to experience nature. Little by little there is recognition that nature exists in cities too, and that there is potential for naturalisation of the urban fabric for multiple benefits. Care should be taken to understand the origins of this shift and its assumptions about the benefits of nature in order to be able to thoughtfully and successfully create the sustainable city. Attention should also be paid to the new ideas of nature that underlie this new approach. Urban nature is a humanly determined nature, a garden, but perhaps not an Eden.

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