

Engineering an Island City-State

A 3D Ethnographic Comparison of the Singapore River and Orchard Road

Stephanie C. Kane

The top layers of the earth's crust have been remade by dense infrastructural, architectural, and sculptural conglomerations through which once-wild rivers flow. Engineers mediate the material interplay of humans and rivers, building subway and sewage tunnels, reservoirs and pipe networks, sidewalks, quays, and blocks of apartment towers to enable urbanist dreams of beauty, safety, and efficiency. Earth scientists stretch cultural geographic understanding of landscapes within geological time. As an ethnographer of water infrastructure in the Anthropocene, I frame understandings of material spheres, decision making, and social action across historical and geological time. Rivers flow in and out of geological epochs into the *longue durée*, the enduring structures underlying the events of human history, and into present-day arenas of socioeconomic interaction. In their effects, time scales proceed simultaneously even as they also move from past to present.

By taking into account geological action, we soon recognize that the sites within which we ground knowledge production about our environments are unstable. In other words, if we are to understand and act upon the knowledge that humanity is a geological actor (and its corollary that "there is no stable point," as Doreen Massey argues), we find that we need to live and work as if we indeed *feel*, not just think, this set of existential facts (Massey 2005, 130–42). Our ongoing conversations in the transdisciplinary space of the Rivers of Anthropocene project can be part of such empirical processes of realization. The site-based specificities of time-tagged processes emerge in tandem from scholarship and from the worlds we study. The insight that the practice of art, science, engineering, history, and culture are indeed entangled encourages us to turn away from institutionalized hierarchies of knowledge production, especially the aspects most implicated in

creating the conditions for the present planetary conundrum. This realization encourages us to perform an open-minded, ethical, and collective *untangling* that re-cognizes diverse and multiscalar interplays among humans, nonhumans, and elemental forces that compose life in earth, site by site.

In my ethnographic practice, I tack back and forth in time and space doing fieldwork at one or more sites in the world and reading relevant scholarly literature; deciphering and tracing the frameworks of interpretation and infrastructural interaction at play; discovering place-based insights, patterns, and processes that can be shared across transdisciplinary riverine space (Kane 2012). To capture and represent the dynamic constellation of forces, conditions, and symbolic meanings that come into play, I extend traditional fieldwork with its “thick description” of particular cultures (Geertz 1973) and work toward restoring the “social thickness” of globalized infrastructural processes in local spaces (Sassen 2006; see also Graham and McFarlane 2015). The Singapore project presented here assembles a human-made geological subject amenable to ethnographic exploration, that is, the three-dimensional, infra-structured dynamics of daily life in riverine neighborhoods. This small piece of the ethnography of Singapore offers insight into a dynamic, shifting pattern between frontstage and backstage river-human action that operates chiefly between meso- and microscale.¹ (In illustration of the spatial range between meso- and microscales consider the “Sumatra Squall,” a line of interlinked thunderstorms accompanied by strong gusts of wind that come across the Malacca Strait to hit Singapore and cause localized flash flooding problems.)

As a tiny, low-lying, tropical, urbanized surface, the island city-state of Singapore is a rich experimental domain. It has been a continuously important node in the global maritime trade networks from the sailing vessels of the third century to the twenty-first century petroleum-based container shipping industry (Malay Heritage Centre 2013; Tan 2016). Freshwater provision for inhabitants and circulating traders has always been a precondition for economic survival. Singapore’s contemporary efforts to assure sufficient supplies while mitigating flash floods have led to extraordinary technological innovations accompanied by islandwide reorganization of its river system.

For the most part, the infrastructural system, called the “hydrohub,” controls water circulation and storage according to plan, allowing inhabitants and visitors to take it for granted. In such circumstances, the river, as a geological actor, becomes the background for more salient stages of human social interaction or remains completely backstage, so to speak, in the “unthought known” of the systems’ unseen underground (Rubenstein and Russell 2010, 9). But when flash floods disrupt everyday life, the character of the rivers as “vibrant matter” brings attention to itself (Bennett 2009). The river, as a geological actor, comes to the front of the city stage, where the inhabitants, its audience, can’t help but appreciate the power of its inconvenient presence.

In this chapter, I analyze frontstage/backstage shifts in the interactional dramas highlighting human and aquatic agency in two central Singaporean sites, Clarke Quay and Orchard Road. In both, the state—motivated by the efficient flow of capital and freshwater—transforms riverine structure, function, and meaning.² Based on fieldwork interviews, infrastructural site visits, and participant observation, I contrast two densely populated cityscapes that have been incorporated into the national reservoir system.³ In the first site, the Singapore River continues to function in the cultural and economic life of the city, but having lost its place as the frontstage of everyday life and livelihood, the river is now relegated to serve backstage functions as a representation of cultural heritage and as water infrastructure. In the second site, an ancient river flows under what is now Orchard Road, Singapore's signature shopping district. A geological trace without contemporary cultural salience, the ghost river waits backstage in the deeper stratigraphic layers of its Holocene past, bursting forth on cue with intense, unpredictably localized rainstorms. Exceeding the capacity of the drainage system built into its former riverbed, the ghost river periodically takes the form of flash floods, disrupting commerce and transport.

As Basso (1996, 41) has argued, ethnographic study of landscapes points to “the symbolic attributes of human environments and the effects of environmental constructions on patterns of social action.” The Anthropocene approach, however, requires rethinking the ethnographic landscape.⁴ For it is not only humans who extract and project meaning upon the landscape; the earth's elemental forces are themselves actors that reconfigure the landscape. And indeed, rivers can disrupt our basic assumptions about terra—dry land—disruptions that structure our notions of the landscape and our modes of territorializing space (Kane forthcoming). The Anthropocene approach to aquatic flows also requires 3D geovisualization.

So in the case of Singapore, for example, the surface and ground waters run at different speeds but simultaneously through the streets, canals, and drains. In effect, they co-create the landscape with humans as they appear and disappear. Engineers systematically measure these flows through the hydrohub, adapting the islandwide water infrastructure to expected input and output rates calculated in reference to historical records. But they have no control over, or even a way of predicting, where and when sudden rainstorms will flash; climate change will only diminish the usefulness of historical data in their calculations (Whittington 2016). Surges of aquatic unpredictability can shock those with expectations of routine control of water resources even as they are lulled back into routine when the human-river time frames resynchronize.

This chapter engages with current research on meaning and action related to island surface topography by focusing on three-dimensional infrastructural arenas of urban river landscapes. Contrasting Clarke Quay and Orchard Road, I propose that collective human agency (here guided by a wealthy, pragmatic state) changes planetary history by moving and repurposing the material staging grounds—the

riverine landscapes and infrastructures—of social interaction. The power to redesign the frontstage and backstage of human activity in the earth's crust exists in tension with the limits asserted by rivers. The tension around the dubious human power to predict and control rivers, I suggest, is a key feature of the Anthropocene.

WATER SECURITY IN SINGAPORE (GEOPOLITICS)

By the time Singapore became a sovereign republic in 1965, citizens had already elected the party that continues to dominate parliament today (the People's Action Party, PAP). The continuity of organizational decision making that this political formation allows contributes to the viability and micromanagement of infrastructural projects large and small. The government has made water a top national security priority, investing much of its great wealth in turning vulnerabilities (scarcity, pollution, flooding) into engines for innovation (Lee 2015; Lee and Ong 2015). The cleanup of the Singapore River in the 1970s—which entailed eviction of all the small boats called lighters (*tongkangs*)—was the first major attempt of its kind to improve water quality in Asia.⁵ The lighters once carried cargo from the big ships in the port into the heart of Singapore's business district. Together with other traditional tradespeople who had lived and worked along the river, the people who worked the lighters played an important role in the island's development as a global center of maritime trade. Victims of urban-environmental renewal and the shift to containerized shipping, they had no choice but to leave (Dobbs 2002). Today, the Singapore River, empty of all but a few tourist and government boats, is integrated into the islandwide reservoir system while most of the people who once inhabited its waters live in public housing towers.

The Public Utilities Board (PUB) is the government agency responsible for integrating and managing the river as part of the island's water cycle. It has established Singapore as a global hub of research on water and development of water infrastructure (PUB 2012). The PUB has accomplished this engineering feat while "creating aesthetic waterways to enhance the urban environment" (Lim 1997), even as their central objective remains: to regulate the balance between a healthy water supply and flood control.

Producing Potable Water as Transnational Geopolitics

With two monsoons and no dry season, water scarcity in Singapore is not due to insufficient rain. Rather, there is not enough land to store the abundant rain. In 1961 and 1962, while still a British colony, Malaysia signed two agreements with Singapore assuring the continued transfer of water through three large pipelines across a 2 km causeway from the Malay Peninsula to the island. (Singapore buys raw river water, treats it, imports it, and also sells some treated water back to Malaysia.) When, in 1965, Singapore was expelled from the Malaysian Confederation, which it had briefly joined after freeing itself from the English, the separation agreement

affirmed the two prior water transfer agreements. One ended in 2011; the other remains in effect until 2061. Although stable, the arrangement is a source of recurring political tension (Lee 2003). The neighboring Indonesian archipelago, which has supplied Singapore with labor and sand for land reclamation, is another potential supplier of raw water—and another source of political tension (Ong 2004). Anticipating future wrangling with its neighbors, Singapore is eager to centralize and diversify its water supply (Tortajada 2006). All of its own major rivers have been recruited in this effort. To keep the nation's freshwater separate from seawater, rivers have all been dammed and interlinked through a series of reservoirs. The many streams and creeks have, so far, evaded incorporation into the reservoir system, although they are directly in the sight lines of engineers who may eventually be able to tap all existing freshwater sources, even the smallest ones. Experimental desalination plants can now shift inputs from fresh to salt with changing conditions, thereby offsetting some of the higher energy costs associated with the desalination phase (PUB 2012). If the hydrohub is to become a global engineering model, the “enclave ecology” it creates requires critical scrutiny focusing on the consequences of banishing estuarial habitats (Kane 2017).

Techniques of Stabilization in Flood-Prone Topography

Prior to infrastructural transformation, forty basins drained the island's undulating topography of rounded hills. Local, brief, and intense rainstorms filled the narrow, short, steep streambeds of the basins, eroding the subdued spurs, carving gullies that carried sediment down the broken slopes to the valley bottoms where the floods spread in sheets across estuarine flats. Before all the post-1982 land reclamation projects, 20 percent of the island was below water at high tide (Gupta 1982). Urbanization has been accelerating these hydraulic processes, putting global city development and the accompanying creature comforts that engender citizen complacency (e.g., air-conditioning) at cross-purposes with water management. The resulting problems generate anxiety in the populace and in the government (Taylor 1934, cited in Gupta 1982).

Like urban rivers around the world, Singapore's rivers are hybrids of nature, culture, and engineering. Understanding the historically changing “techniques of stabilization” that sustain and reconfigure riverhood entails analysis of infrastructural practices and dispositions as they unfold differentially in space and time (Joyce 2010). Today's postcolonial authorities are not so unlike previous British colonial authorities who engineered “norms and forms” of the built environment to enhance the flow of economic activities through Singapore's port. These norms and forms function as “social technologies [and] as strategies of power to incorporate, categorize, discipline, control and reform” island inhabitants (King 1990, 9; see also Yeoh 1996). The mammoth islandwide drainage system, composed of over 803 km of concrete-lined conduits and earth drains (Lim 1997) is one such technique (or complex of techniques) of stabilization. Ubiquitous low-paid, non-Singaporean

workers, subject also to the legal norms and forms of immigration, can be regularly observed carrying out the everyday micro-practices that keep the system free of debris.

As key actors, engineers in Singapore and elsewhere are beginning to shift away from the traditional “rational approach” to urban infrastructure that relies on the pure calculation of pathways (streams), sources (rain), and receptors (drains). They are shifting toward a more holistic (but no less rationalized) “risk management” approach that is more sensitive to the complexities, uncertainties, and struggles evoked by urban flood episodes. Balancing the probability that events will occur with the probable consequences should they occur, risk matrices delineate the biophysical, hydraulic, and weather signals used to guide decisions about whether and when to trigger intervention (e.g., raise floodgates) (White 2010; Task Force 2012). Citizens’ reports and interpretation of localized flash flood events can support official decision-making processes based on risk matrices. PUB has created a website and phone apps through which citizens can participate; however, the extent to which their participation can meaningfully shift top-down, techno-managerial approaches is an open question.⁶

WHAT HAPPENED TO THE SINGAPORE RIVER? THE CHANGING MEANING OF RIVERHOOD

Intervention in the shape, function, and meaning of the Singapore River combines principles from engineering, architecture, aesthetics, and law. A continued focus of intense governmental intervention, the 3.0 km long Singapore River serves a central urban area of 3,707 acres and is a key element in the islandwide reservoir system. The century-old river walls that protected its banks were recently reconstructed to assure continued structural integrity. Refinished with granite, the walls also conserve the river’s unique historical character, contributing to the ideological production of Singaporean identity as a landscape of global trade that has unfolded through colonial and postcolonial history. The bed was deepened to meet the drainage needs of the urban catchment area, and laws have been rigorously enforced to protect the drainage system (Lim 1997). Riverside quays were redeveloped to support contemporary tourist restaurants, bars, and related businesses in a uniquely functional blend of colonial British and tropical Southeast Asian styles that mimic the old to create a sense of distinction and continuity in the new. The rooftops, sidewalks, and decks on Clarke Quay, for example, coordinate patterns of crowd movement and rest and protect pedestrians from rain and sun. Architectural and infrastructural functions blend, such that a network of tubes channels freshwater directly into the river-reservoir system, preventing contamination by street pollutants (fig. 10.1).

Once river-dwelling traders were swept off the river’s sanitized surface and tucked away in apartment towers and most commodities began to move through



FIGURE 10.1. The codesigned infrastructure-architecture of Clarke Quay captures rain and keeps tourists dry.

containers and truck docking nodes on the seacoast, the Singapore River no longer existed as the frontstage of everyday life. On Clarke Quay, as elsewhere, frontstage performance has shifted to land's edge. The river has become the backstage, or backdrop, to face-to-face transactions. As is usually the case when examining social life, everyday practices blur boundaries, including those between, above, or below the front- and backstage. In addition to their primary functions, infrastructures often perform an important though often unrecognized, secondary, unplanned function: infrastructures materially manifest socially *unassigned* spaces—even in the most controlled settings. Among the tightly organized city spaces, liminal spaces allow some escape. The space under a bridge, for example, may allow men to escape the gaze of employers, employees, and tourists. In the tightly regulated zone of Clarke Quay, they share a smoke and conversation offstage (fig. 10.2).

Such alternative possibilities in the cityscape go unmarked on maps. But the ethnographer can easily locate liminal spaces betwixt and between the crisscrossing infrastructural layers. In countries less disciplined than Singapore, graffiti writers and artists seek out the infrastructures that mediate more controlled zones because they provide material surfaces for illegal painting (Kane 2009). Although the Singaporean state restricts these outsider expressions, it nevertheless appropriates



FIGURE 10.2. Layered river infrastructure provides offstage social interactional space for people to escape more tightly surveilled front- and backstages of the Singapore River.

the creative power of graffiti style by hiring muralists to “activate” the pedestrian underpasses connecting different quays along the river with iconic, nationalist images of the river’s rich history (fig. 10.3).⁷ Given this opportunity, the graffiti artists bring the figures and events of Singaporean history back into this ghosted estuary. (For surely at high tide in rainstorms, before the hydrohub separated the river from the sea, the mix of fresh- and salt water would have once exceeded the current hardened banks and nourished the nonhuman creatures who once lived there.)

The material semiotics on the surface tell much about how the state engineers the river’s cultural ecology. However, I argue that underground clues are imperative to understanding the techno-cultural formation of the twenty-first-century Anthropocene. The structures are so large and elaborate that they provide paleontologists with stratigraphic evidence marking human biosphere engineering (Williams et al. 2014). Beneath the architecture, infrastructure, and socio-techno-spatial organization of Singapore’s surface, there is a well-lit, air-conditioned, parallel world of movement and habitation. Vast twenty-four-hour networks of consumption and transport host much of everyday life, providing relief from the exceedingly hot and rainy climate. It is underground, in the Clarke Quay Metro station, that the ethnographer comes across a material representation of the river’s past: a replica of



FIGURE 10.3. Streams of images, pedestrians, and water intertwine along the underpasses linking touristic neighborhoods along the Singapore River. A nod to freedom of expression, the Singapore River One project appropriates the aesthetic power of graffiti art. This fragment interprets the “Lion City.”

a series of four paintings by Chua Ek Kay, one of which depicts the displaced lighters haunting the surface of the once-busy river above (fig. 10.4). This river’s history has been both usurped and preserved. It has vanished and then rematerialized as art: ink brush strokes on a screen; a pictorial landscape intruding like memory on the consciousness of a public taking escalators up and down the geological layers of time under the river. Thus, the river’s *longue durée* is an element in the ideological production of a national past, a stratigraphic layer gesturing to the importance of what once was. Hydraulic engineering is also a way toward reimagining community (Anderson 1999). The remaking of place produces the nation, relying as always but differently on the Singapore River. The process of keeping the once socially active river trading zone alive as tourist backdrop, turning history into artistic material objects in various media, repeats in all the different touristic sections of the river.

The landscape encodes the multiple national objectives achieved through integrated storm water and freshwater management. Back on the surface of Clarke Quay, gazing downstream, the monumental Marina Bay Hotel and Casino looms over the skyline, an emblem of Singapore’s nodal position in world financial flows. The triple-tower structure, linked at the top floor in the shape of a long boat, is a



FIGURE 10.4. Rendering the displaced lighters of the past for Metro riders: what was above, goes below; what were material transactions of everyday life becomes symbolic reminders. One of four “Reflections” by Chua Ek Kay, 2001, in the Art in Transit exhibit, Northeast Line of the MRT, Clarke Quay station.

key feature in the complex organized by the Marina Bay Barrage. The Marina Bay Barrage is a dam system with doors and pumps that opens and closes the hydraulic connection between the Singapore River, the reservoir system of which it is a part, and the sea (figs. 10.5a, 10.5b). In the development of the river-canal-reservoir system, water supply and flood control functions are enhanced for financial, recreational, aesthetic and environmental purposes (Lim 1997). The diversity of these urban spaces camouflages the systematized hydraulic connections among them. In fact, the Singapore River water flows down into the reservoir behind Marina Barrage, where it mixes with surface and underground flows from Orchard Road.

FLASH FLOODS ON ORCHARD ROAD’S CRUSTAL ACCUMULATIONS

Earlier in the geological epoch of the Holocene, the sea rose up and retreated from the islands of what would become Southeast Asia. Rain-fed rivers drained the valleys, and then the sea refilled the valleys with marine sediment (Gupta 1982, 138–39). Thousands of years later, in colonial times, a main thoroughfare was



FIGURE 10.5A. Looking downstream toward what was once the river's mouth, the Marina Bay Hotel and Casino represents and produces Singapore's moneymaking future.



FIGURE 10.5B. The Marine Bay Barrage regulates the island's floods and the freshwater catchment system.



FIGURE 10.6A. The frontstage designed for elite guests of a luxury hotel on a flood-prone bend in Orchard Road. Fragments of sculptures by Botero and Anthony Poon.



FIGURE 10.6B. A section of the Stamford Canal provides a backstage social interactional space for upscale hotel and mall workers to take a break.

established on top of the marine sediment of one such ancient streambed. In the nineteenth and early twentieth century, farmers carried fruits and vegetables to market along this thoroughfare, hence the name, Orchard Road. In the opposite direction, scavengers collected night-soil in buckets from residences and businesses, bringing it to the farms uphill—a practice that became a focus of contention between municipal colonial authorities and the city's Asian communities (Yeoh 2013). By 1980, Orchard Road was enveloped by the city center; humanity's crustal accumulations already blanketed 80 percent of the riverbed (Gupta 1982, 143). Subsequently, when the Orchard Road corridor was cleared for the Mass Rapid Transit (MRT) stations, a variety of religious temples, mosques, and chapels were demolished and relocated (Kong and Yeoh 2003). Like the lighters on Singapore River, the religious groups were given no choice but to make way for urban development. Today's Orchard Road hosts a stretch of mostly high-end, global palaces of consumption, residence, and business that together have become a symbol of national pride (Kong and Yeoh 2003). High art and architectural front spaces service elites, while infrastructural back spaces, like the Stamford Canal, provide a place for workers to take breaks (figs. 106.a, 10.6b).

Yet, despite wealth and futuristic engineering savvy, it is simply not realistic to expect flooding in Singapore to be totally eradicated. At any moment, freak storms coinciding with high tides cause havoc. The colonial-era Stamford Canal, reconstructed in 1978 and again in 1986, runs beneath and beside Orchard Road collecting and diverting surface waters. At the Marina Bay end, the open canal was closed off and now supports a spacious promenade. Its capacity, however, occasionally diminished by debris-clogged drains, can still be woefully insufficient (as in flash floods of 2010 and 2011). Localized flash floods from heavy tropical rainstorms may last less than an hour, yet still cause vehicles to float away from their parking spaces (Lim 1997). The PUB encourages owners of larger buildings to invest in computer-monitored flood walls that protect key entrance space as well as in internal water storage tanks that temporarily hold excess back from the public drainage system, giving it a chance to clear.⁸ Many people who work in the more flood-prone parts of Orchard Road think that the state should provide sufficient, effective infrastructure so that they are not victimized by flash floods and so that the futuristic image of Singapore as a twenty-first-century mecca for the rich and aspiring is not muddled by wading shoppers and ruined (not always insured) merchandise, furnishings, and equipment.

As an entity without cultural salience (except among scientists, including social scientists), the river that shaped the topography of Orchard Road has disappeared, ghostlike, into the ancient past. When intense rains fall into the valley sculpted by this prehistoric river, the rain and topography summon this ghost. Flash floods can assume the force and form of the lost river and challenge the existential premise that the geological deep is fixed in our past.

CONCLUSION

Can there be a good Anthropocene?

Jai Syvitski, “The Anthropocene—from Concept, to Geological Epoch, to 21st-Century Science and Public Discourse”

Vast investments and hugely creative and destructive technology can drive back the reckoning, but cheap nature really is over.

Donna Haraway, “Anthropocene, Capitalocene, Plantationocene, Chthulucene”

Building our environments into the crust of the earth, humans revise the planetary surface, shifting the stage of social interaction in dynamic relationships with aquatic flows (Kane 2012). Singapore’s futuristic engineering of island water, its nearly complete transformation of hydrology into hydraulic engineering, is a tiny piece of the larger puzzle of the global transformation of the planet’s river systems (Meybeck and Vörösmarty 2005). The tightly governed, wealthy island city-state provides a particularly illuminating case of the never-ending tension between the quest for control (here managed with unmatched technical efficiency) and the chaotic possibilities inherent in technologized human-river relationships (here pinpointed with frustrating exactitude). There are an uncountable number of parallels variably enacting this infrastructural tension in the world’s cities. In the nineteenth and early twentieth century, when most cities engineered their way into modernity, they did so in part by covering rivers, often selected for the degree of sewage effluent polluting their courses. Rivers were rerouted under streets, enhanced with electric and water distribution networks, and lined with architecture, and in the best of places, enhanced with art. Many cities unintentionally built central streets on paths sculpted by ghost rivers. This—and all that came before this—is still happening. We can track the dynamics of riverine appearance and disappearance. Researching the frontstage/backstage shifts across geological and historical time can reflexively inform science, storytelling, art, and policy. As the shifting relationships between rivers and cities unfold in the places studied and in the scholarship itself, the dynamics may inspire new ways of imagining the future. (Mary Miss’s installation art comes to mind for the ingenious ways it brings the taken-for-granted White River literally into personal reflections of city inhabitants.)⁹ Filtered through the different modes of knowledge and media production, the focus on front- and backstage urban transformations and riverine ghosts are simple analytic tools that can align inquiry, representation, and action in the transdisciplinary space of the Anthropocene.

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NOTES

1. Goffman's (1959) theory of frontstage and backstage concerns the construction of self and the performance of identity. Individuals manage information about themselves in a variety of ways, one of which is moving into and out of different settings, e.g., taking off makeup backstage after performing onstage. I extend these terms to analyze the dynamic and layered shifts across spatiotemporal scales. I upend Goffman's assumption that "a setting tends to stay put" (24) to consider how states (and other entities) reassemble entire settings (and their infrastructures), switching up activities in the frontstage and backstages as they globalize local capabilities. Graham (2010, 18) also finds Goffman's frontstage/backstage metaphor useful when analyzing disruptions caused by urban infrastructure.

2. As actors in networks, meshworks, and assemblages, humans can calculate and intend but not control. Material forms lacking intention, like rivers and rock, can shape events in linear ways that conform to engineering models or in nonlinear ways that appear chaotically. The predictability of their agency, or action in the world, varies with the situation. For more on this approach, drawn from the social study of science and technology, see Mitchell 2002 and Latour 2005; as applied to seismic science and communications infrastructure in a tsunami, see Kane, Medina, and Michler 2015.

3. The fieldwork project in Singapore (conducted in May 2013) is one in a series of studies of water management in the context of environmental change. The chapter draws on data from sixteen interviews with scholars and engineers and twelve visits to key infrastructure sites. For further detail on ethnography of infrastructure methods, see Kane 2017.

4. Thanks to Ashley Carse for this insight.

5. Interview with David Higgitt, Department of Geography, National University of Singapore, May 6.

6. <http://www.pub.gov.sg/managingflashfloods/Pages/default.aspx> and <http://www.stomp.com.sg/>. Both accessed 3/8/14.

7. See www.singapore-river.com. Accessed 3/8/14.

8. Interview with building supervisor, Orchard Road, May 13.

9. See <http://www.imamuseum.org/visit/100acres/artworks-projects/flow>, <http://www.marymiss.com/index.html> (accessed 7/6/16); and Miss and Carter, this vol.