Infrastructure as Method

(Supplementary chapter for *Pipe Politics, Contested Waters*)

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This supplementary chapter outlines the research design and methodology that animated the fieldwork for Pipe Politics, Contested Waters*. In surveying this methodological terrain, I show shows how water infrastructures were simultaneously an object of inquiry, as well as the medium and methodological entryway for studying those same processes. The chapter attends to some of the challenges – material, practical, epistemological – that I encountered and navigated in the field, probing some key aspects of ethnographic research design and practice that can sometimes go unspoken: framing a research question; figuring out how and where to go looking for answers; trying out different strategies; adjusting, adapting, experimenting, and even sometimes discarding particular techniques when they prove misguided or unhelpful. While these sorts of discussions are generally edited out of published manuscripts – as indeed it is in Pipe Politics – I offer them here to make a separate argument regarding the relationship between ethnography and methodology.*

Ethnographers of the global present face particular methodological challenges – challenges that have perhaps always haunted the ethnographic enterprise, but that have bubbled to the sociological surface lately in especially demanding ways. To state the problem simply: how can a methodology (i.e., ethnography) that is premised on the production of knowledge through immersion in 'local' worlds be put to work in producing knowledge about a world animated by processes that are so clearly *translocal*? How can ethnographic methods make sense of dynamics that are neither territorially nor temporally bounded? This essay probes these problems through a discussion of the research design and methodology that animated the fieldwork for *Pipe Politics* – an approach that took Mumbai's water infrastructures both as an object of inquiry (infrastructures are the material form of urban transformation and contestation) and as the medium and methodological entryway for studying those same processes. In surveying this methodological material, the essay attends as well to some of the challenges – material, practical, epistemological – that I encountered and navigated in the field.

The questions around which the research for *Pipe Politics* coalesced emerged from a relatively straightforward empirical puzzle: on the one hand, official statistics, media accounts, popular discourse and casual conversation hold that in the city of Mumbai, dry taps are common, water is frequently scarce, many areas of the city are not connected to the municipal water distribution system, and millions of people simply do not have access to any source of water. And yet, on the other hand, life in the Mumbai not only goes on, but thrives – economies grow, festivals and marriages are celebrated, literacy rates rise, the dead receive last rites – in spite of this supposed absence of water. Starting from the basic premise that life in the city (or anywhere, really) is simply not possible without water, the empirical question becomes one of access: how *does* Mumbai meet its daily water needs?

In starting my inquiry from the methodological entry point of puzzles and surprises, the research draws on what semiotician Charles Peirce's (1934) calls "abduction":

> Abduction is the process of forming an explanatory hypothesis. It is the only logical operation which introduces any new ideas; for induction does nothing but determine a value, and deduction merely involves the necessary consequences of a pure hypothesis" (Peirce 1934: 171).

Abductive inquiry recognizes that the perception of empirical phenomena as surprising in the first place depends upon a researcher's familiarity with myriad existing concepts and theories – sociological or otherwise. Directing research attention to what strikes the researcher as unexpected or surprising allows for the calling into question of taken-for-granted, even latent categories and concepts which are unable to account for some phenomenon (hence the surprise), and thereby opens up space for other understandings, meanings and possibilities to emerge (Paavola 2005; Peirce 1934; Reichertz 2007; Timmermans 2012).

While I arrived in Mumbai in August 2008 with pretty a clear idea of the puzzle that animated the project, figuring out how and where to begin to look for *answers* to the puzzle only raised more questions: what could it mean to carry out 'participant observation' of something (water) that flows mostly underground through pipes and aquifers, and is therefore readily amenable neither to participation nor to direct observation? And how, moreover, could I organize a study that would allow salient analytical categories and explanatory frameworks to emerge *through* the research process itself without presuming in advance – at the stage of fieldsite selection and question formation – what those frameworks and categories might be? These questions were not only material-practical but epistemological as well. Regarding the second question – concerning available categories and explanatory frameworks – it became clear immediately on arrival in Mumbai that the received narratives and conventional explanations (both popular and scholarly) for the city's water woes had little relation to readily apparent geographies of water flow and access in the city. For instance, the common wisdom that Mumbai's spotty taps evidence the material and sociopolitical unraveling of the urban fabric along class or community lines sits uneasily alongside some clearly evident features of the city's actually-existing hydrology – features that I encountered as soon as I took up residence in the city.

Indeed, the research for *Pipe Politics* began at home, where I first encountered three features of Mumbai's waterscape that most readily complicated the conventional stories that the city tells itself about its water troubles. The first feature I encountered is that Mumbai's water taps are – by and large – dry by design. The city's water distribution network is not configured to provide continuous pressure, but rather works as a "sump and pump" system: through an elaborate choreography that involves the daily operation of more than 800 valves, the water department supplies water on a rotating basis, pressurizing the network first-here-then-there for a few hours per day.[1] Water that comes out of taps during these hours is stored and/or further distributed through creative (largely non-municipal) configurations of tanks, pumps and pipes and hoses. In the neighborhood where I took up residence in fall of 2008 – a middle class housing society that I'll call Amar Gardens[2] – our water was supplied from the municipality for around two hours

[1] For reasons that I outline in chapter one of *Pipe Politics*, some of the oldest areas of the city on the southern-most tip do have continuously-pressurized taps, as do some of the newer suburbs

[2] Except when unavoidable, all locational and personal names have been changed.

per day, each afternoon between 2:00 and 4:00, during which time water flowed from our water connection onto the housing society's below-ground storage tank. Every evening, the society watchman would switch on a pump to lift the water from the underground sump to a holding tank overhead. From the overhead tank, the watchman then released the water during two half-hour intervals – once in the early morning and once again in the evening – by opening a valve. When the watchman opened the valve, the water would flow from the overhead tank to each of the 48 buildings' separate underground sumps, from where it would be once again pumped up to storage tanks on the roofs of each of the individual structures. The rooftop storage tank our house's rooftop tank was affixed with an automatic sensor that switched on the electric pump whenever water in the rooftop tank fell below a certain level; there was a similar sensor in our house's underground sump that would switch off the automatic pump if the water level fell short. All of which is to say, while the water pipe feeding connecting our society's tank to the municipal distribution network was indeed dry for approximately 22 hours per day, for practical purposes the taps in my kitchen and bathroom were constantly and consistently pressurized with municipally piped water, 24-hours per day.

A second surprising feature of Mumbai's actually existing distribution system about which I quickly learned upon taking up residence in Amar Gardens is that – in contravention of popular wisdom and scholarly discourse – water does not flow readily along class or community lines, and the legal quality of one's home does not go far in predicting what flows or doesn't flow out of some water tap. For instance, according to Amar Gardens' water meter, during the period of research our housing society received approximately 40 liters per capita per day (lpcd) – roughly a third of the municipal supply norm for residential consumption, and a quantity that is on-par with levels of municipal water consumption in some of the poorest, legally-precarious and socially-marginalized localities in which I researched.[3] To make up the water shortfall, our housing society Amar Gardens supplemented its 40 liters per capita per day of municipal water with by waters from two additional sources: a surface well and a borewell (as well as with an occasional water tanker; see Method 3B below).

Indeed – and this is the third commonsense-subverting feature of Mumbai's water infrastructure that taking up residence in Amar Gardens readily revealed – Mumbai's piped water supply coexists with myriad artisanal water provisioning systems in the city. The M-East Ward where I carried out the research for *Pipe Politics*, it turns out, was only connected to the municipal water distribution network quite recently – in the 1950s – when the annexation of suburban territories by Bombay City suddenly rendered the municipality responsible for providing water to an area over six times the size. At the time of annexation, the area that would become M-East Ward (then known as Trombay Island) was inhabited primarily by fishing villages and agricultural settlements whose residents relied exclusively on the abundant locally-available resources (freshwater wells) for water needs. In 2008-2010 the house in Amar Gardens where I lived received a daily quota of water from the society's old surface well located on the society grounds. The well, which predates the society's founding in the 1970s, had until recently gone unused. When the society began to experience water trouble sometime in the 1990s, (a subject that I take up in chapter five of *Pipe Politics*) monthly housing society dues were used to clean up the well, fix it with a pump and to lay

[3] See Chapter five for an extended discussion of this unexpected and important finding.

a network of pipes through which a small amount of water was made available to each of the houses, whose residents mostly used this water for gardening (although in 2009, the acting society secretary began to look into possibilities for filtering the well water in order to render it potable). More recently, my landlords, Dilip and Priya, hired a groundwater consultant, who (with the help of an able, water-divining coconut) located an underground stream only a hundred feet below a patch of grass in the garden, just adjacent to a small tree. The couple hired a contractor to tap the stream, which was then affixed with a pump, a small storage tank with an automatic sensor.

The borewell works like this: when the water level in the tank drops below a certain level, the pump switches on, replenishing the tank until the water rises to a certain level – at which point the pump again switches off automatically. The borewell is generous, comfortably able to fill the 1000 litre tank in under ten minutes. From the tank, the water from the borewell is pumped up to the roof of the house, traveling through a pipe that is colored fire engine red in order to distinguish it from the grey ones that convey municipal water. Once on the rooftop, the water from the underground stream is stored in a separate tank, which is adjacent to and slightly larger than the one holding municipal water. From the *municipal* water tank, the grey pipes snake downward along the outsides of the house, occasionally disappearing through the wall and into each of the three flats. Inside the flats, the grey pipes fed taps in three locations: one of two taps in each kitchen (connected to a water filter that renders the municipal supply doubly-safe for drinking), one of two taps in the shower and the bathroom sink (as Dilip explained, since the mineral-rich water from the below ground would corrode the solar powered water-heating system, they use filtered municipal water in the solar panels; the hot water taps are fed by grey pipes). All the other taps in the house (as well as the toilets) were fed by red pipes carrying water from the well. In Dilip and Priya's house, in other words, the waters remain separated all the way to the point of consumption; they never mix, except when the hot water (municipal) and cold water (underground stream) mingle just before bursting out of my shower head.

The Municipal Corporation has taken a deeply-ambivalent and historically contradictory stance regarding groundwater, its governance never officially figuring into the water department's policy framework, but never disappearing either. In 1960s, for instance, the Municipal Corporation launched a drive to infill and pave over city wells, which were proclaimed to be a public health risk. But more recently, during the summer of 2009, the water department did an about-face, launching a drive to clean out a number of area wells – those located on both public and private lands – thereby implicitly acknowledging what is well known in Mumbai: while entirely ignored by municipal water policy, groundwater continues to comprise central component of the city's actually-existing water infrastructure.

All of which is to say that these three unexpected features of Mumbai's water distribution system, which I encountered at the very outset of my research in Mumbai, demonstrated to me that city elites negotiate the very same, highly heterogeneous socio-material and political terrain of infrastructural practice as the city's marginalized and poorer residents in getting water and in hedging the everyday risks of infrastructural breakdown. This of course does not mean that class and community did not matter for how people get water; on the contrary, financial and social resources are leveraged in all sorts of ways to hedge the everyday risk of shortage (see chapters two and four and five). The point is that there was a

clear disconnect between the political language and discursive categories through which infrastructural politics in the city were commonly described and explained, and the configurations of pipes and practices by means of which Mumbaikars actually accessed municipal water. Rather than presume from the outset that water practices map onto politically-articulated categories (the poor, the illegal, the subaltern, the marginalized), I realized that understanding water would require a methodology that would explore of the social and political fields and practices through which water access is produced – as well as the everyday activities to which everyday risks of shortage give rise – without over-determining the explanatory role of things like class, caste, or community or law. With available categories and explanatory frameworks unable to account for the puzzles posed by Mumbai's water taps, I needed a different methodological point of departure. Ultimately this boiled down to the question of how to go about selecting fieldsites: I needed to identify research sites that were neither geographically bounded units (a "slum" or a "gated enclave") nor sociologically defined groups ("Muslims" or "middle classes") but rather that would work as points of entry into broader infrastructural process. How were these fieldsites to be selected?

Because it is simultaneously an electoral, administrative, and hydraulic unit, I decided to begin my research from the geographically contiguous M-East Ward, and to allow my inquiries to engage other scales as and when the relevance of other scales emerged through research. As I explain in the introduction to *Pipe Politics,* my selection of M-East was strategic:

> [T]he neighborhoods, businesses, and industries of M- East are supplied water from a single local reservoir. Working with this unit of analysis allows for an exploration of hydraulic relations between different locations: who or what is upstream or downstream from whom, for instance, on a particular distribution main. Accounts and insights emerged from a wide range of social, political, and geographic positions within the water distribution network, each location functioning as a particular lens through which broader political and social processes are explored.

The size and heterogeneity of M-East, however demanded that I be intentionally selective also about precisely *where* in the ward to focus my ethnographic attention. Drawing on initial observations preliminary findings during the first months in Mumbai, I generated seven analytically distinct categories of water-access *possibility* – later adding an eighth, which I discuss below – that I then further subdivided into fourteen sub-methods. These eight "methods" of access, it must be emphasized, are *not* a set of categories through which water access practices were described by research participants. The eight methods are neither emic categories, nor are they the organizational or analytical framework through which *Pipe Politics, Contested Waters* is organized. Rather, they were categories that I generated after the first few months in Mumbai expressly for the purpose of selecting fieldsites – sites where I would be able to learn about the wide range of actors, institutions, discourses and material processes to which my findings during those first months of research suggested I ought to attend. The eight "methods" are simultaneously ways of accessing *water* (meaning that the "methods" are infrastructures of water access) and also ways for accessing *knowledge* about water. It is in this latter sense that water's infrastructures are the method of research.

During the months and years of fieldwork that followed, many of the analytical categories, concepts and distinctions that I had initially used in organizing these eight logics collapsed under the weight of ethnographic inquiry – the distinction, for instance, between "illegal" and "legal" water connections which I discuss below at length. I preserve them in this essay not only because the categories were instrumental in informing my research process and site selection, but because the collapse of certain concepts and categories under empirical scrutiny raised the important question of how to account for their striking salience and discursive power in the first place. Interspersed with the discussion of each of the various methods and the fieldsites through which I explored them are a handful of "methodological interludes" (which are offset in italics) in which I attend to particular theoretical concerns – of ontology, positionality, epistemology, and geology. While discussion of these sorts of processes is generally edited out of published manuscripts – as indeed it is in *Pipe Politics*, *Contested Waters* – I offer them here to make a separate point about the relationship between ethnography and methodology.

M-East Ward in Mumbai

Eight Methods of Access

1. Getting the Water Delivered: Municipal Water Connection:
    - 1a. Getting a consumer connection
    - 1b. Getting Water to Flow From a Municipal Connection
    - 1c. Accessing Water From a Municipal Connection
    - 1d. Non-Members Accessing a Municipal Connection
2. Getting the Water Delivered: "illegal" Connections
3. Getting the Water Delivered Through Tanker Trucks
    - 3a. Municipal Tanker; Municipal Water
    - 3b. Private Tankers; Municipal Water
    - 3c. Private Tankers; Bore-well Water
4. Getting Water from the Ground
    - 4a. Surface Wells
    - 4b. Bore-Wells
5. Going to the Water: Retail Water Markets
6. Forgotten Pipes
7. Bringing work to water
8. Rain

Method 1: Getting the Water Delivered: Municipal Water Connection:

Sub-method 1A: Getting a Consumer Connection.

I begin with what might at first blush seem to be a rather straightforward possibility for accessing water: out of a pipe, connected at the far end to a pressurized municipal water main, reaching at the near end to some place where the water can be obtained by opening a tap.[4] While this initially a rather straightforward means of obtaining clean fresh water, it quickly became apparent that this is not the case. Obtaining approval for a municipal water connection is fraught with obstacles: requirements of residence proofs for example, are a challenge – and not only for people whose homes might be of ambiguous legal status (vis-a-vis zoning laws or land tenure requirements for instance), but also for those whose residence in various structures might be difficult to demonstrate (renting tenants for instance). When how are these documentary obstacles navigated? Who is successful in obtaining permission for municipal water connections… and who is does not? Given the vague and sometimes contradictory documentary requirements for obtaining permission for a municipal water connection, how are connections to the municipal water system produced in practice? What's more, as the distance between a residential

[4] This section is somewhat longer than the others because it encompassed such a broad range of actors, institutions, and socio-material processes and practices.

structure and a pressurized water main can be significant, the laying of a consumer connection can an expensive affair; who bears these costs, and/or how are costs circumvented or mitigated when they prove prohibitive? Once official permission for a new water connection is approved or granted, how is the attaching of the new connection actually carried out? Who performs this work and what work do they actually do? Who decides to which water main a new connection will be attached? Who, moreover, has the knowledge of which distribution main has water and which does not?

I researched the processes of obtaining of permissions and of making new water connections from three sites. The first is a neighborhood known as Shivajinagar-Bainganwadi – a working class municipal housing colony dating from the early 1970s. I selected two locations within Shivajinagar-Baingainwadi: one older area that is closer to the water distribution feeder main, and a second, newer area, which is situated at a location further downstream on the distribution main. The first is an older block (or "plot") with many long-standing residents as well as a large number of more recent arrivals – both home buyers and renting tenants. There are some larger, two-story homes as well as some tiny structures, and the plot sits on the border between a primarily Maharashtrian Dalit area, and a neighborhood that is home primarily to North Indian Muslims. I focused my inquiry on one lane and a back alley that, at the time of research, had 36 separate residences and six water connections – two of which were owned by a single family. Three of the connections were quite old – as old as the oldest houses in the neighborhood – while three were newer. The newest connection was only a few weeks old at the time I began research, a recent investment by residents on the east side of the street who had grown tired of the 'tyranny' of the family with the two connections – the only two connections that (at that time) had actually yielded water.

A third site from which I researched in Shivajinagar-Bainganwadi is a more-recently settled area at the edge of the adjacent garbage dumping ground. This neighborhood is far from any water main and the structures were of ambiguous legal status. Like the two sites described above, the area is situated on land that is owned by state government and held on a long-term lease by the Municipal Corporation. The first two sites described above, however, are situated on land zoned for residential use, while the third site is *outside* of the residentially-zoned area; residences in this third area, in other words, have an ambiguous relationship with zoning law (the area is not zoned for anything at all). Notwithstanding the vagaries of zoning, there was at least one metered and pressurized connection, which belonged to a lower-level political party worker who lived in the neighborhood. While I had expected that official, legal status of a structure might be an important factor in determining access to piped water, this turned out to be not at all the case. Indeed, as Chapter Four of *Pipe Politics* demonstrates, the absence of documents can sometimes (but not always) be financially costly, but it not an insurmountable obstacle to obtaining metered municipal water connection; the bigger challenge is convincing the tap to actually produce water. And it is *this* challenge more than 'legal' hurdles that led many people simply not to bother with the expensive and time consuming process of obtaining official permission.

Besides these three residential sites in Shivajinagar-Bainganwadi, I studied the forging of municipal water connections at two additional non-residential sites. Firstly, at the constructions site of a Slum Rehabilitation project (see *Pipe Politics,* Chapters 2-4) I explored the multi-phased trajectory by means of which municipal water to the constructions site was made to flow: from the securing of 'temporary'

drinking water connections for construction workers (a mandatory step before a Commencement Certificate to build a building is granted by the Mumbai Municipal Corporation), to the arranging of consumer connections before a Building Occupation Certificate is granted. This research allowed me to explore, for instance, how and by whom the sizes of various water connections were decided, and the processes by which location points for a new construction's connection to the municipal network are selected

Finally, in an effort to attend to a common theory (popular among elite and non-elite Mumbaikars alike) that taps were volatile because locally available resources were constantly (and 'corruptly') being diverted for commercial-industrial purposes, I researched the local branch of a beverage bottling company. Consistent information about the number and size of the company's water connections was not readily available, and at the time of research was the subject of an ongoing political debate and investigation. My insights into the bottling company's water connections came largely from five sources: first, from a local elected official who received information from sympathetic union workers who leaked information from inside the plant; secondly, from the information that the head of the local water department shared with this politician; thirdly, the information that same water department official shared with *me* (which incidentally was very different from what he shared with the politician); fourthly, an anonymous Right to Information (RTI) application (filed by an activist friend on my behalf), and lastly, observations and conversations while making rounds with the *chaviwallas* (key men) who open and close underground valves allowing water to flow. My research at the bottling plant explored the relationship between each of these mutually-irreconcilable accounts (on the one hand) and what may or may not flow underground through pipes (on the other).

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Methodological interlude 1: ontology

As my research at the bottling plant demonstrates, one of the biggest methodological challenges I encountered concerned how to deal with the ontological status of the water distribution system. My research did not seek to produce an 'accurate' account of some independently-existing world out there; rather I approached this issue from a constructivist principle of inquiry that presumes the things I was trying to understand and my thoughts about those things were part of same process, cut of the same cloth. My job was therefore to learn about infrastructures of water access by drawing on my own encounters and experiences, paying careful attention to my own positionality in various situations in order to produce knowledge claims. The more intertwined I became in the processes about which I wanted to learn, the more I could hope to know about it. As Pachirat (2009: 144) writes, explicit attention must be paid to "relationships among perspective, power, and the ethnographic voice, and the way these relationships shape not only what is seen (a question of access), but also how it is seen (a question of the production of ethnographic knowledge itself)."

These philosophical commitments seemed all well and good when I was sitting in the library in New York; but once I reached Mumbai, they suddenly came to seem abstract and impractical. Surely, I wondered,

there must be an actually-existing network of pipes and flows and water pressures down there under the ground somewhere… right? Hydraulics happens, in other words, and I needed to work out how I was going to deal with it. At first, I felt an anxious compulsion to 'get the facts straight' about the distribution network. As I describe in the book (particularly in chapters one and five), getting my hands on various maps of the distribution network had initially seemed the most sensible way to begin my research; once I had maps, I had reasoned, I could tack them up on my walls and then refer to them as I proceeded. I had envisioned pressing colorful, meaning-laden pushpins into these maps, whose patterns would then reveal to me important geographies of flow and access and blockage. But getting my hands this sort of objectively mapped knowledge turned out to be less straightforward than I had anticipated. Indeed, while I had imagined that procuring maps would be a jumping-off point in my exploration, instead the processes of locating, gaining access to, and attempting to make sense of various 'maps' of Mumbai's water supply network became themselves some of the most fertile and generative sites for ethnographic research. As I write in chapter six:

> *At one point I drew all the valves I knew of onto a map, overlaying each water supply zone with translucent paper onto which I traced meandering blue lines in an attempt to render visible—to actually see with my eyes— the spatial relationships between flows of water to different areas. These efforts were frustrated by the deeply fragmented nature not only of my own knowledge of the underground network but of the grid's very knowability. For instance, I was immediately confronted with the problem of reconciling conflicting accounts of the locations of pipes and flows. In an attempt to resolve this, I began to use different shades of blue to represent "rumored" flows and "official" supply. Yet this effort was complicated by the reality that even "official" knowledge of the grid is multiple, conflicting, infused with rumor, and in some sense based on speculation—either mine or someone else's. In retrospect it became clear that more important than finding out what really happened was the irresistible draw to speculate on what may or may not have happened (Björkman 2015: 189).*

Becoming aware of my own hand-wringing around the 'accuracy' of various maps – anxieties that impelled frequent and compulsive visits to one particular sub-engineer whose long tenure in the neighborhood afforded him a particularly deep and intimate familiarity with local hydrology – allowed me to see that the knowledge objectified in maps – knowledge that I had initially sought out as a starting point to the research, inhabited a deeply contested field of speculation, expertise and power. The politics of knowledge about the pipes and flows emerged as central theme of the book.

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Sub-method 1B: Getting Water to Flow Out of a Municipal Connection:

Having a metered and documented municipal water connection is no guarantee of actually getting water; while some municipal taps produce water when opened, others do not – even when taps are side-by-side. Why are some connections pressurized while others are dry? I researched the production of pressure at four sites, each of which corresponds with a distinct pressure-related dynamic: first, one can live downhill

(this certainly helps) and preferably close to a pressurized water main. Secondly, someone with a dry connection can put a booster pump (motorized or hand-operated) on their connection to actually suck water out of the pipes. Thirdly, someone with a dry connection can arrange to have their pipe 'transferred' upstream to a place on the water main that has better water pressure (those with more knowledge – or access to better information – can avoid the transfer costs by getting their connection attached to a well-pressurized main to begin with). Finally, water pressures in different areas of the ward throughout the day is orchestrated by the valve operators (*chaviwallas*) who drive around with big iron rods ('keys') opening and closing valves (more than 800 across the city are opened and closed daily, according to department estimates) by inserting metal keys into underground keyholes, turning them a certain number of times in one or the other direction. The number and direction of turns are closely guarded secrets to which even the highest level engineers do not have ready access; the chaviwalla position is a career position and the information is passed down orally and by demonstration to new recruits.

I selected four sites from which to observe the pressurization of pipes: three plots in Shivajinagar-Bainganwadi (which I call Plot A, B, and C) and (as a fourth site) the chaviwallas' jeep, in which I accompanied the valve operators on their rounds. Gaining access to these various sites was a bit of a delicate affair due to the political sensitivity and legal complexities of many of activities involved. So while sustained ethnographic attention to each of the sites lasted only a month or so, I spent upwards of six months prior (in conjunction with research in other fieldsites) working out how best to negotiate and navigate entry and where to position myself (given the fraught relations among various actors even residing on the same block).

The first of the four fieldsites from which I researched Sub-method 1B is Plot A in Shivajinagar Bainganwadi. Plot A is close to pressurized water mains but has a mixture of wet and dry connections. The second site, Plot B, is just a stone's throw to the north of Plot A but is without a single productive connection (although it boasted plenty of dry ones). Plot C, for its part, is not really a gridded plot (see *Pipe Politics* chapter four), but rather is a peripheral neighborhood that, at the time of research, was nowhere near to any water main at all and which therefore had long-distance tangles of one-inch diameter and ¾-inch diameter pipes stretching up the lanes inside drainage ditches towards pressurized mains, of which at least one (sometimes two) actually produced water. In order to learn something about which pipes produced water and why, I conducted extensive ethnographic research and interviews in these three sites, learning the age of connections, the materials from which connections made (i.e., plastic or steel), the legal status of the documents and the plumbers who have made these connections, the history of work and transfer on the pipe, and the present locations at which consumer pipes are attached to underground water mains.

The two lanes that I studied in Plot A had six water connections serving 36 separate structures (both commercial and residential). Of the three oldest connections (dating to the early 1980s according to these residents) one is attached to a hand pump (which was provided by the municipal corporation in the 1980s when a growing population left many connections dry) and the other two are attached to a motors, which are used to increase the pressure in the pipes. No connection in this neighborhood produced water

without the aid of a booster pump – however the pumps are often insufficient to produce water from the pipes. The motorized pumps, moreover, are illegal and water department officials play a cat-and-mouse game with people who own motors; there are a number of very productive connections, which use very strong motors to extract a lot of water which is then sold to people living both in areas without water connections, as well as to residents with dry pipes (which municipal engineers argue are dry because of the upstream online motors). When I began observations, these three connections had been dry for a number of years (although at least two of them were said to produce yellowish water on occasion). The other three connections were productive, but two of them had water flowing from 4:30-6:30am while the third had water only from 5:30-6:30am (after some failed attempts at reconnection, the third connection finally found its way onto a water main with more pressure in December 2008).

Plot B I selected because it was puzzlingly devoid of pressurized municipal taps despite its location in the heart of Shivajinagar-Bainganwadi, its proximity to a long-established water main, and the relatively secure legal status of the area's residents (many of whom have lived there since the late 1970s). Plot B was interesting for its proximity to Plot A – which is a relatively wet plot with a bustling water market. Through oral histories and mapping pipe routes, I researched when and how Plot B's pipes went dry, and why it has been such a challenge to get water to flow out of them again.

Water connections and taps become scarcer towards the east side of Shivajinagar-Baingaiwadi, but there were a few, and the peripheral neighborhood that I studied (Plot C) had at least one pressurized connection. This pipe snakes its way the length of six blocks before it reaches a live main. This ten-year-old connection had a spotty history; a thick file of complaints (most carrying signatures of high-ranking Congress Party officials) and water department recommendations/responses documents the history of this occasionally-productive water connection. In the run-up to the general election in April 2009, some of the long-dry connections suddenly became productive again, although most people (correctly) predicted that the situation would not last. Interestingly, some long-wet areas also dried up in the run up to the election, which some observers – notably the local police – insisted was also, somehow, related to the upcoming election.

Sub-method 1C: Gaining Access to Water That Flows Out of a Municipal Connection:

Coaxing water out of a connection is one thing, but who actually *gets* the water that flows out of a pressurized, authorized municipal connection? In upscale housing societies, popular neighborhoods, and everything in-between, new municipal connections are granted not to individual households, but to 'societies' – in the case of bungalow societies or high-rise apartment buildings – or to 'lines' in the case of so-called 'slum' neighborhoods (which are only eligible for connections in groups of at least five households – households which, according to municipal regulations, must be living on the same block and on the same side of the street; see *Pipe Politics,* Chapter 4). Research on this sub-method sought to understand, for instance, how much water each household actually gets from its municipal water connection, particularly given that as many as 40 households can share a single connection that yields water for only a few hours per day.

My research on this dimension of water access emerged from fieldwork in two sites. The first was the housing society where I lived during the period of research – Amar Gardens. The society's water allowance had slowly declined over the decade prior to research, and residents had increasingly turned to other sources of water (deliveries by tanker, digging bore-wells, cleaning long-abandoned surface wells) to meet their everyday water needs. During the time that I lived in Amar Gardens there were two periods of particularly acute shortage of municipal supply. Living in the society, I learned about range of efforts and practices employed by members to secure municipal water (for instance, the stealthy and disallowed attachment of motorized suction pumps on the society's internal distribution network grid), the conflicts and tensions produced by such efforts, and the techniques of persuasion that were employed in efforts to coax society members to voluntarily cut back consumption of municipal water for non-potable purposes.

At my other site of observation for Sub-method 1C – Plot A in Shivajinagar-Bainganwadi – I conducted intermittent observations over 6 months, and much more intensive, daily observations for three weeks. I was fortunate that the weeks during which I conducted intensive observations were particularly dynamic as the timings had just been changed, from 4:30-7am to 6:30-9am. The disruption of any established order introduced by the new timings change allowed me to witness the renegotiation of water-access practices. While at first glance I had expected that some kind of seniority might determine who got how much water – and while most people on the block *allege* that this is the case – I discovered a much more interesting set of dynamics, in which the visual complexity and blind spots of the neighborhood (the tangle of same-colored pipes snaking along the lane, the location of most water storage drums in the back lanes, and the darkness, which lasts until almost 7:30 in the winter) opened windows of opportunity for some savvy members to access significantly more water than others (see chapter six of *Pipe Politics*).

Sub-method 1D: 'Non-Members' Gaining access to a Municipal Connection:

In Shivajiangar-Bainganwadi, the water flowing out of municipal taps is accessed not only by connection owners, but by outside "members." Accessing water from a consumer connection took one of two forms: firstly, outsider members could buy *time* on a connection - usually a few minutes per day (or every few days) for a set price paid at the start of the month to the household in whose name the monthly bill arrives. The bill payer would use the outside members' money to pay the water bill and then distribute any extra money evenly among the other owners. Alternatively, outsiders could buy *water* (at a unit rate) from the municipal connection (outlined below in Method 5: going to the water). The blind spots and visual complexity described above functioned to blur the line between owners, members and nonmembers. While I was often told that owners fill first (they don't trust the water; pressure could disappear at any time), in practice this was not at all the case. Outside members filled whenever it was convenient, borrowing hoses from one another – and from owners – and directing water into their own barrels just a few feet away. On a number of occasions I witnessed an opportunistic member use blind spots to fill cans of water for sale to the general public, pocketing the few rupees earned. On other days, I witnessed angry arguments, as members and owners who did not receive any water by the time the pipe ran dry accused one another of "excessive thirst" (although I never saw any of these accusers correctly identify any of the people whom I had seen filling more than their share of water on any given day).

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Methodological interlude 2: positionality

Before I began turning up in Shivajinagar-Bainganwadi at pre-dawn water time, I had already spent six months forging relations with people on the block: stopping by for tea and a chat, for instance, or simply hanging about on stoops and unwittingly distracting children from their homework. Once I began to turn up in the wee hours, however, my positionality within that field of relationships changed swiftly and dramatically; I went from being 'part of the family on the block' to being enmeshed in early morning networks of knowledge, access and power. In short, once I started coming at water time, my presence in the chawl became increasingly fraught: one connection owner sought to enlist me in policing the amount of time various households controlled the tap – attempting, that is, to assign me a role that I was eager to avoid since accessing the nooks and crannies of this particular site hinged on being perceived as 'neutral.' In practice, however, there was no way that I could be seen as 'neutral' at water time because watching water meant that I saw and learned things that, as I describe below, weren't meant to be seen. This put me in the awkward position of having to be vague or even to dissimulate regarding what I had or hadn't witnessed. In addition, my futile efforts to remain a neutral observer were frustrated by the reality that in these cramped quarters I was quite simply in the way. The following account, excerpted from my fieldnotes, gives a sense of how these dynamics played in unpredicted and surprising ways.

> *Paniwalli yells at Chacha to attach the hose, and Paniwalli fills house 1B (the upstairs room). Meanwhile Seema comes around to check on the status, she must be getting nervous, its quarter to 8 – only a half hour or so left before water time ends. Paniwalla [Paniwalli's husband] comes over to me and says what are you drawing? I'm drawing a map of the six connections in the chawl, I tell him, of where they're connected to the distribution mains. I ask him where his pipes is connected. He gets angry and he says 'Oh, you're only studying MY connections??' I say 'no no, there are six connections on these two blocks, and two of them are yours – so I'm just asking you about your two'. He doesn't really answer my question and he seems nervous. This is understandable; he doesn't have to answer me if he doesn't feel like it. Sanjeev's wife hears Paniwalla speaking harshly to me and maybe out of sympathy she sends a kid over with tea for me. The neighbor – the guy with spiky hair- looks over and sees me drinking tea and makes a snide comment: 'It must be nice for you sitting drinking tea, I want to be a student too!' I say ,'um, yeah that'd be great' – because I don't know what else to say. I finish the too-sweet tea (she must have put extra sugar to try and cheer me up), give back the cup and go over to sit near Mom's house in retreat; I'm feeling unwelcome and uncomfortable since Paniwalla was so brusque. I'm inclined to just leave, just walk away, but I can't, I've come too far and I can't give up on the neighborhood. But for now I just want to sit quietly somewhere out of the way. But there's no such thing as 'out of the way' here. In any case, they won't let me hide. Now Greenshirt and Sanjeev come over and start in on me. Greenshirt says: ' I'll tell you what to write in your notebook – write that Paniwalla was selling yellow water to the bike people two months ago, write that!' Then he turns his anger on me directly: 'What good do you do anyone coming here and writing in your notebook anyway!?'*

I snap. I glare at him and answer sharply 'Do I do you so much harm coming here at water time? Is it so much trouble to you that I come here that you have to make jokes and say unkind things?' He doesn't say anything, but I'm angry now so I continue: 'Look, if you don't want to talk to me, fine, don't talk to me. But approaching me just to make nasty comments - I'm tired of it. I don't like it.' I'm wishing my Hindi were a bit better so that I could be more articulate in my anger, but I end my tirade with a weak: 'In fact, I don't even want to talk to you at all anymore.' I get up, pick up my bag and storm off around the corner into the back alley, leaving him looking a little bit stunned. He calls behind me: 'Madam!' But I've ducked around the corner and into the lane behind.

Eventually Manju comes back to check on me; she'd heard my angry outburst of course – everyone had. 'I thought you'd left' she says. I say, casually, absurdly, 'Oh no, I'm just back here watching water, talking to these guys..." I try to pretend nothing happened up front. She leaves. A few minutes later Mom comes – she's come to check on me too. Seema brings us both tea, but mom refuses – she doesn't like milk in her tea she says. The woman instructs her daughter to make Mom another cup of tea, this time without milk. Mom notes Seema's new connection and remarks 'Ahh, new connection!' ' Yes'. I can't tell what mom's thinking – clearly she's a little threatened by new connections in her area, she's probably going to lose members, although it seems she's already kicked them all out. If she hadn't come back to check on me she wouldn't have seen the new connection - funny. Mom says, diplomatically, "well it's always good to have more connections." But it's obvious she's stretching to say something nice; she clearly feels uneasy with this new connection with very good water pressure.

Its 8:18, I'm still in the back alley and B is finally filling; I go over to watch. Sanjeev and Greenshirt are there, I avoid making eye contact with them. Mom is there too. She says, cheerily, trying to make peace, 'See, no one is fighting today and everyone gets water easily!' Greenshirt is looking at me, I see out of the corner of my eye. I look up at him, meeting his eye. He says "Sorry." I sort of half smile and nod, 'It's okay,' but I'm still shaken - not in anger but embarrassment for having lost my composure.

Water time ends and I just want to get out of there as quickly as possible I round the corner to the front of the lane, poke my head into Manju's house, smile unconvincingly and tell her I'm heading off. She's washing the floor and looks up: 'Aren't you staying for breakfast?' 'Oh no, not today, I say, I have to run, I'll call you later…' As I walk out Mom catches my arm and says 'Don't be angry with Sanjeev, he's one of ours." I nod, ok. I walk out quickly, unintentionally catching Paniwalli's eye as I go. She smiles sort of sadly, apologetically; I flash a big bright smile trying to hide that I'm fighting tears, and walk down the lane towards the main road. Sweetie catches me at the corner: 'What, you're not having breakfast??' 'Oh no, not today…' I flash another smile and duck away, mortified that after so many months of work my research in the neighborhood had just come to such an abrupt and embarrassing end.

> *The next morning I didn't go to watch the water. Manju called me: "Why didn't you come today?" I told her I wasn't feeling well. "Come tomorrow," she says, and I say ok. And when I showed up the following day it was like nothing had happened at all. Everyone seemed happy to see me and I went about my routine as usual, following hoses here and there, stepping over sleeping children and husbands and the like. At some point during the morning, Sanjeev waved me over. I followed him out to the main road and as we walked around the block he offered, casually, unprompted: "the tap at the head of our lane, it's connected a block up that way." The other, he explained, had transferred a month or so ago to the distribution main along the adjacent lane.*

To my surprise and bafflement, the debacle hadn't ended my research at all. On the contrary, revealing my vulnerability had resulted in more access; losing my composure had bolstered my credibility.[5]

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The last of the four locations from which I researched the pressurization of pipes was the chaviwalla jeep, where I spent six weeks accompanying M-East valve operators on their daily rounds. As mentioned earlier, Mumbai's water distribution system is not designed to be continuously pressurized, but rather works as a sump-and-pump system, whereby the network is pressurized first-here-then-there for a few hours per day by means of the daily operation of more than 800 valves. Water that comes out of taps during these times is stored and further distributed as needed for use throughout the day by means of myriad configurations of tanks, pumps and pipes and hoses. Around 30 of Mumbai's more than 800 valves are located in M-East Ward, and are operated by three shifts of valve operators. I arranged to go on rounds with the chaviwallas after having spent nearly a year researching in various sites across Mumbai's M- East Ward. As I write in Chapter Six:

> The valve operators hold a special mystique in the water department, where engineers express both awe and envy at the depth and command of their knowledge. Indeed while making rounds with the valve operators was not originally on my methodological list of things to do, it quickly became apparent that these somewhat invisible operators play a crucial role in producing water flow and in the city's hydraulic imaginary. For instance, during the months I spent studying the comings and goings of municipal water tankers (which, as the object of much media attention and popular accusations of corruption, was something of a misguided fixation during the early months of research), a sympathetic junior engineer supervising the tanker-dispatch procedure advised me in confidence that if I really wanted to understand the water department and the distribution system, I would have to find a way to access the knowledge of the chaviwallas. "Most decision-making power is in the hands of the chaviwallas," he asserted (*Pipe Politics*: 169).

The chaviwallas open and close valves in three shifts: a morning shift (from 8 a.m. to 3 pm); an afternoon shift (from 3:30 to 11pm); and a night shift (from 11 pm to 7 am). I arranged to spend a week on each of

[5] This point of course echoes Geertz' (1973) classic account of how a sort of 'fellowship of cowardice' with Balinese villagers resulted from having joined them in flight from police raid on a cockfight.

the shifts, exploring the production and circulation of *embodied* forms – as opposed to cartographic or mechanical forms – of hydraulic knowledge.

Method of Access 2: Getting the Water Delivered Through 'Illegal' Municipal Connections

In the M-East Ward, there is a host of licensed and unlicensed plumbers who can arrange for so-called 'illegal' connections. Where, when and how are plumbers enlisted in water work? What is the relationship between the private plumbers, municipal engineers, and the networks of social and material relations that work together to forge these connections? To what extent does a clear distinction exist between 'legal' and "illegal" connections; how grey is the middle ground? I studied the legal-illegal distinction from three different fieldsites: first in Shivajinagar-Bainganwadi (where I conducted extensive observations and documented oral histories of the neighborhood), secondly in a neighborhood I call Ganeshwadi – a popular neighborhood situated on public land that has both older and newer areas, neither of which had – at the time of research – ever been officially 'declared' as a slum; and thirdly, in Amar Gardens, the neighborhood where I lived.

In Shivajinagar-Bainganwadi, thousands of described 'illegal' connections exist in an intimate relationship with those that are sanctioned by the water department. (On one occasion, for instance, I heard a senior water engineer offer to help out an elderly Shivajinagar-Bainganwadi resident by re-attaching the man's authorized-but-dry water connection to an unauthorized but pressurized one that the engineer had just recently cut off and plugged up). Most neighborhood plumbers (licensed and unlicensed) work on both 'authorized' and 'unauthorized' connections. There are only a handful of actually *licensed* plumbers in M-East ward (four or five), with a slew of unlicensed plumbers working under them. These unlicensed plumbers hang about the water department waiting for jobs, presenting photocopies of the licensed plumbers' documents under whose authority they claim to work. The water department engineers depend crucially on this army of unlicensed, semi-legal plumbers for the wealth of knowledge they have about what is underground. The plumbers are often long-time residents of the areas in which they ply their trade, and have intimate understandings of where the underground geographies of pipes and pressures

In a second site – the neighborhood I refer to as Ganeshwadi – older authorized connections have over the past ten years been usurped by local strongmen of various sorts who appear to have created (or are trying to create) a monopoly on water supply to the area. The area is much smaller than Shivajinagar-Bainganwadi – home to about 7500 residents (as compared to Shivajinagar-Bainganwadi estimated 700,000) but serves as one of the biggest and most lucrative water markets in the area. Indeed, it is not uncommon for residents of neighborhoods on the Shivajinagar-Bainganwadi periphery to travel the distance all the way across Ganeshwadi to buy their water, which is available on an almost-continuous basis (my research also investigated the origins of this 'magic pipe'; see Method 6: Forgotten Connections).

The availability of on-demand water in Ganeshwadi is an invaluable service for the residents of surrounding areas whose work schedules do not allow them to wait around for water in the morning –

particularly in the context of the new, later water timings in Shivajinagar-Bainganwadi. During the period of research, however, local residents and activists in Ganeshwadi waged a proxy war against the water cartel. Through a series of well-orchestrated and politically-supported public protests and road blocks, this well-organized, well-established neighborhood demanded new water connections from the local ward office.

The last of the three sites where I researched 'unauthorized connections' was the pre-independence bungalow society where I lived, which had experienced periodic water shortage for the previous ten years. Residents' strategies were multiple, but one interesting episode had happened a few years prior when a well-connected resident had leveraged distant family ties to a senior water-department engineer in arranging for an additional, un-metered connection to be installed to the society's water tank. The connection went undetected for a few years until water stress drove the society secretary back to the municipality to complain. When the engineers came to inspect, they found the additional water connection and chastised the elderly secretary. Then the municipality removed the older connection, attaching the meter connection to the newer, unmetered one – which in any case, was more conveniently placed. This episode provides an interesting contrast to the situations in Shivajiangar-Bainganwadi or Ganeshwadi, where newer political mobilizations and entrepreneurs supersede the claims of the longstanding, 'well-connected' Mumbai elite. The society residents, the secretary was told, should learn to cope with less water; perhaps they should clean up that old village well. Indeed, at the time of research, the society was thinking of ways to avoid the fraught business of making complaints to the municipal corporation about water shortage, looking to locally-available groundwater resources instead.

3. Getting the Water Delivered Through Tanker Trucks

Sub-method 3A: Municipal Tanker, Municipal water

In case of emergencies, the water department keeps on hand a number of municipally-owned 10,000-12,000 liter tanker trucks, which can be deployed with the permission of the ward-level and zonal-level water engineers to areas of the ward that are experiencing water shortage. This water is delivered free of charge (with the exception of tips to the drivers), and since the trucks are filled from a water main that comes directly from the treatment plant, this is probably some of the cleanest water in town. While each ward office is meant to have one tanker at its disposal, M-East ward generally has anywhere from two to five on duty; excessive 'demand' (that is, a large number of 'social workers' crowding into the engineer's office demanding water tankers) in M-East ward led the water department to give M-East ward an additional tanker, and in 2009, to contract a private transport company to provide an additional few tankers. M-East also occasionally managed to 'borrow' a tanker and driver from an adjacent ward, if they were not needed. Each tanker made three to five trips daily, which means that anywhere from 6 to 25 loads of water were delivered in M-East ward daily.

Research on this sub-method explored questions concerning a wide range of sometimes-unexpected actors who performed important infrastructural work. I explored, for instance, who actually receives these tankers full of free, clean water; the official and practical procedures for obtaining them; the means by which each tanker actually reaches its destination. This final point might seem a small one, but in M-East

ward very few people actually know their way around some of the denser neighborhoods, particularly the neighborhood of Shivajinagar-Bainganwadi, where a large number of the tankers are sent. The roads are unmarked, and even the residents know only the few plot numbers in the areas around where they live. Official maps do not have plot numbers listed; the hand-drawn map provided by the water department is at odds with both another one provided by the same department, as well as with that of a well-known NGO in the area – all of which diverge significantly from that of the local police station. How, I wanted to know, do the drivers know where to go? Once the tanker drivers arrive at their destination, how do they know to whom they are meant to give the water? Does the water always reach the person/party who arranged permission for the water? Furthermore, many of the narrower streets are simply not wide enough for a truck – how does the water get out of the truck and into storage spaces from which people can use the water?

I researched the municipal tanker supply system from three sites. First, at the M-east ward office I studied how and when requests for water tankers were sanctioned (or not sanctioned). The ward office is also where the drivers come each morning to receive their assignments for the day. The second site was the filling station where lower-level laborers, drivers, and junior engineers oversee the entrance and exit from the municipal 'yard' where tanker trucks are fill from an enormous hydrant (12,000 liters in as little as eight minutes). The third was inside the water tanker trucks themselves, where I learned about how drivers actually figure out to whom the water has been promised, where the water is intended to go. Many of these tankers are dispatched to popular neighborhoods, where roads are unnamed and little understood. The deliveries are thus dependent on a series of mobile phone conversations, and personal escorts, who meet the truck at some known landmark, and then guide the truck to its intended destination, clearing vegetable markets out of the way, attempting to shoo away other would-be consumers who attempt to block the path of the truck and open the valve.

In addition to these three sites, I eventually selected a few of the neighborhoods that were regular recipients of water tankers as sites from which to further study the 'social workers' who arrange these water tankers for this or that neighborhood. In the run-up to the MP election, for instance, I focused an intense period of research on a series of skirmishes and negotiations among several Shivajinagar-Bainganwadi social workers affiliated with rival parties, who had fought over who would claim responsibility for having brought one particular tanker.

Sub-method 3B: Private Tankers; Municipal Water:

Municipal tankers are not the only vehicles toting municipal water around the city; while the municipality has a fleet of fewer than 30 trucks, the city's fleet of private tankers numbers in the thousands. Some of these tankers carry groundwater (from borewells or surface wells) but a large number are actually carrying municipal piped water. How do private tanker trucks get permission to fill their tanks at municipal filling stations? Where is this water delivered? I researched these questions at two sites: first, at the M-East Ward office, where permissions for requests for both municipal tankers and private tanker deliveries of

municipal water were made and approved or denied. Secondly, I researched at the municipal filling station, where both municipal and private tankers fill their tanks. Indeed, not all applications approved by department engineers for a tanker-load (12,000 litres) of municipal water are also allocated a municipal tanker truck with which to *move* that water from the filling point to the point of consumption; some water applications are granted permission to *purchase* this water from the municipality and then are left to find their own private means of transport 12,000 litres of water from the filing point to wherever its needed. Those who make requests for a municipal tanker-load of water but are not provided a free municipal tanker in which to move that water generally turn to one of the many private transport companies whose trucks and offices line the road adjacent to the filling station.

In the event an application for a tanker-load of water is denied to some applicant, then it is an unofficial practice that the requesting party can ask the tanker company to advocate on the requesting party's behalf. As chapter six of *Pipe Politics* details, many applicants do not actually bother traveling to the ward office to an official application to the engineer, but rather save time by simply phoning one of the various tanker companies. For a set price (from 2000 to 3000 rupees for 12,000 liters – 166 to 250 rupees per thousand liters – 60 times the municipal rate for non-slum domestic consumption) the tanker companies offer to deliver municipal water. How, my research sought to understand, is this accomplished? At the yard where the filling station is located, I explored who gets this purified water (and who does not), for what purpose, as well as which tanker companies are consistently effective in gaining regular access to municipal water.

From among the range of locations to which this municipal water by private tanker was regularly delivered, I selected a few as fieldsites: one which had applied through the ward office engineers, and another that had skipped that step and had gone directly to the tanker company. The first site was a university that had been consistently successful over the previous two years in obtaining permission for municipal water for delivery by private tanker, but which had recently switched tanker companies (three times) because of suspicions about the origins of the water – both because of pricing and (after a few dozen students fell ill) due to concerns about the origins of the water; the university secretary suspected they were inadvertently being supplied with well water (water quality analyses eventually lent justification to these suspicions). A second site was selected from among the 69 slum rehabilitation buildings at Lallubhai Compound (a site from which I also researched method 1A). In Lallubhai Compound, a few of the buildings were regularly provided water by private tanker, while a few buildings were regularly provided municipal tanker. The remaining (and vast majority) of the buildings had no regular tanker provision at all. From among the buildings, I selected one that received municipal water by private tanker, two that received by municipal tanker, two which received groundwell water by private tanker (see next section) and two with water shortages but that received no tanker water at all, and two buildings which somehow seemed to have adequate water from the municipal pipes.

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Interlude 3: epistemology

At the outset of my research in Lallubhai, I made a somewhat-misguided attempt to discern the geographies water flow and access by mapping various layers of knowledge about infrastructural configurations of each building and by overlaying these strata of knowledge (literally, with tracing paper) onto maps of the water distribution system. I was hoping to get a sense of any patterns, for instance, between configurations of 'online' suction pumps and geographies of access. Quite quickly, however, the layers multiplied: one of the maps I made color-coded Lallubhai's buildings according to whether they were inhabited, partially inhabited, or empty; another showed whether each building had formed a housing society (with the colors varying once I discovered that some buildings have a few competing housing societies vying for legitimacy and authority); a third showed whether a buildings society is registered; a fourth map depicted electoral districts at municipal, state and central levels; a fifth showed whether the building's housing society (if there was one) claimed or admitted to having a submersible suction pump attached to their water connection; a sixth then depicted buildings accused by adjacent buildings of having submersible pumps; a seventh for accused buildings whose societies or residents denied these accusations; and finally, an eighth for quantity of water received – divided into three color-coded categories: more water, average, less.[6] Layering the translucent, colorful sheets over one another, however, failed to reveal any interesting or discernable patterns at all. Instead, my carefully, vibrantly colored schemas appeared as a rainbow of muddy browns. It thus became evident that given how many factors might influence where water flows and does not flow in Lallubhai, focused ethnographic attention on these complex dynamics in a few select buildings would prove much more generative. Indeed, carrying out research in a selection of buildings that might vary along all axes, as a variation-finding sort of 'comparative' study would recommend, would not only have taken so many years, but moreover since so much of this knowledge is so sensitive, it cannot be gathered through either 'neutral' observation or through straightforward interview. Rather, understanding the interconnections among all these various dynamics demanded protracted periods of participant-observation ethnography in a few, carefully chosen fieldsites. In the end, I conducted participant-observation ethnography during "water time" – when the housing society's maintenance person opens the valves that allow water to flow from the rooftop water tanks to the floors below – in five buildings (with sustained observations conducted regularly for 5 months in one of these five). I carried out research in other buildings according to insights and suggestions that I gathered along the way: one building that was particularly successful at commanding water tankers; another that had managed to have new connections laid by the municipality; a third that had an "illegal" connection laid by a neighborhood plumber, diverting water from the main feeding a neighboring slum into the water tank of the building.

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[6] I carried out these mapping exercises through a selection process that might be described as 'intentional.' Time and resources precluded carrying out ethnographic research in 69 buildings, so I sought out a variety of buildings.

Sub-method 3C: Private tankers; Bore-well Water

I carried out in-depth research with one private tanker company - a smaller company with only 6 trucks, which I'll call 'Rajeev Transport' – and interviews with two other much-larger companies. Rajeev Transport supplied water to three sites: highway gardeners working on contract for the municipal corporation; a ready-made concrete plant that supplied yellow trucks full of pre-mixed concrete both to slum rehabilitation projects as well as to luxury high-rise developments; and finally to an old Slum Rehabilitation transit camp in Mankhurd - a decade-old neighborhood of 10x15 foot concrete huts built as "temporary" housing for people displaced by the World Bank-funded Mumbai Urban Transport Project (MUTP). The camp, which was only intended to house displaced families for a short time, was never granted municipal water connections. But as the scale of the MUTP project – the processing and resettlement of over 20,000 families (one of the largest human displacements in recorded history) outsized the capabilities of the NGO placed in charge of the resettlement process, thousands of families are still waiting to be re-housed, many still living in transit camps like the one in Mankhurd. The transit camp is supplied well water by Rajeev Transport on Thursday and Sunday mornings, which the residents come and collect in buckets and pots – an activity which occupies the better part of both of these days.

Method 4: Getting Water from the Ground

The introduction to this essay outlines three features of Mumbai's actually existing water infrastructural system that problematize some of the readily available theories about the city's water struggles. One of these – the third – is that Mumbai's Mumbai's piped water system coexists with a wide variety of artisanal water access practices. Among these, as I outlined in my discussion of Amar Gardens, is the practice of drawing water from the ground through surface wells and borewells. To understand the various factors involved in these processes (as well as the relationship between groundwater use and piped water use) required that I learn something about material, legal, and epistemological lives of the city's geology and hydrology.

Perhaps because of the legal ambiguity regarding groundwater ownership rights in India, there has until recently been relatively little official data on groundwater. In 1997, the Government of India's Ministry of Water Resources established a Central Ground Water Authority, charged with periodically surveying the country's groundwater resources, formulating basin-wise plans, and coordinating with other governmental agencies in managing groundwater use. The Ground Water Authority has district offices in various parts of the country that have been identified as heavy-extraction zones. Mumbai, however, has no district office that maps and monitors its groundwater. The reason for this was explained to me by Central Government official named Gupta, a geologist who had been sent to Mumbai on deputation as a consultant advisor to the Municipal Corporation's Rainwater Harvesting Cell during the drought of 2009. The failure of the 2009 monsoon ignited a somewhat short-lived preoccupation with rainwater harvesting among the city's political classes – a development that incited geologists like him (as well as many municipal engineers as I would learn) to no end.

As Gupta explained to me, the water table is so high in Mumbai that water is readily available through shallow, open wells. For this reason his agency had never seen any need no need to invest mapping and monitoring information about groundwater or it's extraction through borewells. By Gupta's assessment, any non-potable water needs could easily be met in Mumbai using ample water from surface wells. However given the sky-high price of land in the city, the idea of using open land for ringwell was not a terribly attractive proposition among landowners and developers: 'People prefer six-inch diameter borewells over big ringwells" Gupta sighed; 'they're riskier, the borewells, because they're expensive to dig and they can dry up. But much less land is used.'

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Methodological interlude 4: geology

To make sense of what all of this might mean for research purposes (what are the stakes? Who are the stakeholders?) I needed to learn about the city's geohydrology. Here, of course, I again ran headlong into the set of epistemological problems I outlined in Interlude 2: how to reconcile the constructivist ontological premise of my research with the need to understand a bit more about what goes on underground – at least so that I could select relevant and generative fieldsites? Ultimately I found work of Science and Technology Studies (STS) extremely helpful: rather than taking a position on the truth value of 'scientific knowledge' about the city, I set about instead to make sense of how and by whom various kinds of knowledge about the geo-hydraulic body of Mumbai were produced, circulated and used – how, when, by whom and to what end (see Latour 1987). And here again our government geologist was wonderfully helpful (my interviews with Gupta numbered four in total, and involved a series of site visits as well):

> *There are two parallel rock ridges that run along the north-south axis of the Island City, Gupta explained, one on the west side and one on the eastern edge. These ridges are made of a kind of basalt known as 'trap rock' or 'weathered rock.' If one were to dig vertically, they would encounter one or two meters of 'black soil,' before encountering weathered rock, which extends to a depth of 10 or 15 meters. Weathered rock is so called because of its many fractures. Along these fractures flow the monsoon rains, which run like small underground streams until they hit more solid rock below. During the rainy season, this upper strata of rock overflows within the first few weeks of the monsoon, thereby achieving complete recharge of the water table (Mumbai's water table fills up at 500mm Gupta told me; the city gets around 2500mm of rain during the three-month monsoon). Surface wells in Mumbai out to be dug to around 30 feet, at which depth they can be expected to recharge relatively quickly during the rainy season.*
>
> *Below the weathered rock is a second 'zone' of less-weathered rock. This goes a little deeper, maybe up to 70 feet, Gupta speculated. Below this we encounter kala pattar – or 'black rock' – which extends many hundreds of feet into the ground. Kala pattar is also a form of basalt (like weathered rock), but is much, much harder than weathered rock and with far fewer fractures. Water thus collects in 'zones' Gupta explained – aquifers at depths of hundreds of feet, that fill as water slowly drips from the water table over many years. This is the water can be accessed with*

a borewell: a hole a few feet in diameter but anywhere from 100-400 feet in depth (in Mumbai) – like a long skinny surface well that connects to an underground lake. In Mumbai, Gupta explained, bore wells dug to depths greater than 200 feet can lead to saline incursion because of the proximity of the salt water (Mumbai is comprised of a cluster of islands in the Arabian Sea after all). Empty aquifers, exhausted from pumping, can fill up with seawater can then seep into other aquifers and streams through cracks in the rock (even kala pattar has some fractures). Borewells dug to depths of a hundred feet are relatively safe from saline incursion, but in some parts of the city bore wells are being been dug to over 400 feet.

On reclaimed land (for instance, the slum rehabilitation complex of Lallubhai compound), digging a well is infinitely more complicated. Even though there is no impermeable or hard-rock barrier separating ground from sea on reclaimed land, however, Gupta explained that there will be a sweet water zone in the water table, as deep as the reclamation itself. In Mumbai, however, because much reclaimed land was created out of municipal refuse of various sorts, the water held in these lands will invariably be polluted with heavy metals, industrial contaminants, or pathogens. So technically speaking surface wells can be dug, but the water will be of questionable quality. Some neighborhoods on reclaimed lands are experimenting with small, shallow wells, but public outcry over possible health hazards complicate such efforts, even if the water is to be used only for flushing toilets or for industrial purposes.

Gupta had been deputed to Mumbai to help the Municipal Corporation conduct case-by-case geohydraulic surveying – feasibility reports – for individuals and housing societies applying for permission to set up rainwater harvesting units. His job was to help locate groundwater, which entailed a two-step process: first, information from older topographical maps was to be juxtaposed with more recent remote-sensing data to assess whether a proposed well is on solid ground or reclaimed land. Second, Resistivity Meters were being used to help estimate potential groundwater depth. The geologist explained that locating an aquifer is not an easy procedure since even the most technologically up-to-date equipment is notoriously imprecise on calculating the depth of an aquifer, or its holding capacity. Digging a bore well is far from an exact science Gupta shrugged. And indeed, during my research, most of the people I met cross-checked their ground-penetrating sonar equipment with other, time-tested forms of divining - generally involving coconuts.

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Sub-method 4A: Getting water out of the ground from surface wells

The M-East Ward is populated by a handful of fishing and farming villages nestled in the back alleys between high rise buildings and sprawling industrial complexes, and which are dotted with open surface wells, many of which are now neglected and used as garbage receptacles, but some of which are maintained, stocked with water-cleaning fish and turtles, and used for daily water needs. To study surface wells I selected two such wells (in addition to the already mentioned one at Amar Gardens): one whose

waters were used for domestic purposes I and a second that had been leased out for commercial purposes. My research sought to understand who uses the water from these wells (as well as who does not) and the various uses to which the water is put.

A village landowner had leased one of his village surface wells to a private tanker operator, which I'll call Prakash Tankers. For a set monthly rate, Prakash Tankers was granted exclusive access to that particular well. There was one additional well in the village which was used by a diverse cross-section of people for a variety of purposes (see Method 7). The other wells in the area were either filled in with garbage, grown over with algae, or now were situated within the boundaries of adjacent co-operative housing societies. Through conversations with the landowners and villagers, I gathered oral histories of these village wells, their historical and present uses. I also was able to conduct interviews (but no participant-observation) with a ready-made concrete plant that had subcontracted water supply to Prakash Tankers. This allowed me to map the trail that this well's water follows – out of the ground and into the rain-impermeable concrete epidermis that is gradually spreading across the city's surface.

Sub-method 4B. Getting water out of the ground through bore-wells

It is very easy to get permission to dig a hole and draw out water – either using a motor-driven suction pump or a hand pump. Sometimes the water coming out of these wells is brackish and sometimes it's fresh. There are thousands of bore-wells in Mumbai, and there is very little regulation, save the permissions (ostensibly) needed from the Pest Control wing of the municipality's health department to have a private company dig a well (no public agency digs wells). Groundwater laws in India give unlimited groundwater rights to whoever owns the land on which a well is dug, but not all areas of Mumbai's eastern suburbs produce fresh groundwater. Much of M-East – like the rest of Mumbai, discussed in the previous chapter – is reclaimed from tidal marshes. For research purposes, I selected as a fieldsite the 69 resettlement buildings of Lallubhai. At the time of construction, the builder (the state government's Regional Development Authority) had arranged with the water department for only drinking water from the municipal supply – a move inspired by the unavailability of water at the time the buildings were constructed (see *Pipe Politics,* Chapter 3). The builder's plan had been to dig borewells for each building from which water for non-potable purposes would be made available. However these plans were foiled by the unfortunate geological, um, rediscovery that Lallubhai is situated on reclaimed land; when the builder's contractor set about drilling borewells, they hit the sea. At the time of research, Lallubhai had only eight bore-wells, four of which were functional, all of which were either so brackish soap would not lather, visibly oily, or both.

There were a handful other fieldsites where I researched the use of borewell. The first was Prakash Tankers, which had leased two borewells situated on private land (in addition to the surface village well discussed in the previous section), and from which Prakash supplied a variety of industrial and domestic clients: a ready-made cement company; the municipal highway gardens, a government 'transit camp' housing families displaced by urban development projects. I also studied borewell water from middle class housing society whose residents stoically coped with their dwindling municipal water supply (and their dwindling social power to do anything about it) by digging private bore-wells at personal cost. The society

hiring a team of geologists (and coconut-wielding diviners who cross-check the geologists' predictions) to do groundwater assessments in order to understand whether their neighbor's new well will tap into their own subterranean source, and took to grumbling about which 'stingy' neighbors had yet to dig a personal well, and which ones continued to flush the society's limited drinking water supplies down their toilets. Finally, I studied bore-wells in in a hill-top area, adjacent to the Bhabha Atomic Research Center where the municipality once-upon-a-time had provided hand-pump wells to older popular neighborhoods on private lands, whose elevation has cut whole swaths off from (gravity-fed) municipal water supply.

Method 5: Going to the Water

Rather than having water delivered – by the municipality or by some private supplier – many people actually travel to a water source and carry the water back to the place where it is used. Hiring a tanker to bring water is one way of doing this (discussed in the last section); alternatively, people go on foot, bicycle, auto rickshaw, or taxi and collect water in smaller vessels.

Sub-Method 5A: Retail Water Markets

At water time, many popular neighborhoods of M-East ward come to life with bustling water markets. People generally buy water in the open market by the 40-litre plastic can – one of cheapest and most readily-available water vessels on the market – or by the pot or jug (*haanda*), which come in various sizes, and whose price tends to vary dramatically as pot sizes are not standardized. Water cans are generally transported on bicycles. Anywhere from one to seven cans are transported at one time, hung off of the frame of sturdy steel bicycles – rented by the hour – with iron hooks and pushed by hand, the weight of the water generally precluding more conventional means of riding a bicycle. The can-and-bike method was used almost exclusively by men (I only saw one woman pushing a bicycle in all my months watching water). *Haandas*, by contrast, are open-topped jugs which are carried on the head (for longer distances) or hip (which is more exerting and less comfortable, but can be lifted alone; getting the *haanda* up to the head tends to require a helping hand), and this is how women generally carry water (although it is not uncommon to see men carrying *haandas*, men usually carry *haandas* on the shoulder, sometimes on the head, rarely on the hip). I studied water markets in Shivajinagar-Bainganwadi Plot A (described above). In Shivajinagar-Bainganwadi longer-termed residents tended to have older connections, which also tend to be dry. If the residents are within reach of a live connection, they can become outside 'members,' as discussed in Method 1; if there is no proximate pressurized connection, residents must go to collect water on foot. There is often a tense relationship between these older residents with dry connections, and the water sellers, whose powerful motors are both the presumed culprit ('they suck the network dry!') as well as the solution (even families who do not sell water need a motor to coax water out of their connections) to the lack of water pressure in the pipes. My research in Shivajinagar-Bainganwadi sought to trace the water geography to the patterns of settlement over the past few decades and to the locations of original water main. Extracting water from the municipal distribution network by handpump or motorized pump is a very old practice in the area, where the unavailability of private municipal connections has long

compelled community leaders to extract enough from the handful of live connections to provide for a whole area.

Method 6: Forgotten Pipes

Over the half century prior to the period of research (2008-2010), the M-East Ward went through some remarkable transformations – changing from a quiet neighborhood of fishing villages and state-owned industries, to a densely populated area mostly known for its towering garbage dump (and important scrap trading and recycling industry), sprawling 'slums' (in 2008 the area's state legislator got into a heated argument with his counterpart from central Mumbai – home to the Dharavi neighborhood made famous by the Oscar-winning film *Slumdog Millionaire* – about whose area *really* contains 'Asia's Largest Slum'; according to local authorities, the Shivajinagar Police Station *alone* is responsible for 1.2 million people), and mushrooming high-rise buildings (both slum resettlement and high-rise luxury constructions). The speed of transformation is dizzying and the water department long-ago abandoned its efforts to maintain a mapping staff that would keep pace with changes on the ground (See *Pipe Politics,* Chapter 1). As well, the constant transfers of engineers inside the water department (engineers are usually transferred between wards for promotions every few years; only the laborers remain in a single ward year after year) means that very little knowledge about the subterranean city is actually accessible to the department. Similarly, as the residents of M-East's popular neighborhoods are relatively recent migrants (the earliest settlers came in the 1970s), knowledge of the underground network is often based on rumor. People talk about 'discovering' pipes when they began to leak, their hidden contents puddling above ground. Some older residents may remember where these pipes are, what they were for, but the younger generation tells tales of water discovery: first we found this source, then that one. The origins of these 'forgotten pipes' and the routes that they follow become the stuff of myth, speculation, and political possibility.

I researched 'forgotten pipes' from two sites. The first was a neighborhood that I'll call Bhim Nagar. Bhim Nagar has three pipes, two at one end of the neighborhood – one about 3 inches in diameter, one about an inch and a half - and one at the far end, also about an inch and a half. During the period of research, water time began around 11:00 am, when water gushed out of the pipes and pools in big muddy puddles in which people stood while they waited to fill buckets and pots. At the moments when the crowds thinned out, the water continueed to fall freely, interrupted only by the ever-present young boys who waited on the sidelines for an opportunity to jump in and splash around in the water; at the time of research there was no way to shut off the water (at the time of writing this situation has changed). For the first hour or two (the water flows until 3 or 4pm; sometimes it comes back after 8pm for an hour or two), the water from the pipe emitted a sewage-like stench and sometimes the pipes produce bits of black debris. Women used this stinky water for laundry; some women did their laundry around the pipes, squatting on rocks; others carried the water back to their homes. Once the water stopped stinking, the laundry-doers disappeared and people crowded around to fill drinking water vessels.

Bhim Nagar's water pipes were unique in M-Ward, where 'free water' was something of an oxymoron. My other forgotten-pipe fieldsite – Ganeshwadi (see Method 2) – was home to a very lucrative water market. The neighborhood is small, probably around 8000 people living in 1500 or so homes, and is

situated on swampy public land that is under long-term lease to a private soap company. The soap company closed down years ago, and the area quickly filled up. The older parts of the neighborhood date from the 70s; the newest are from the past decade or so, rendering their legal tenure ambiguous. The older parts of the neighborhood were granted municipal water connections a decade ago, but water pressure – which was never sufficient to begin with – slowly decreased. The unconnected majority in Ganeshwadi foraged for water – first from near Mankhurd Railway Station, where the joint of an underground water main produced above-ground puddles, which people manicured and maintained as a fresh-water pool. In the past two decades, burst joints have fed such pools in various spots, which astonishingly appeared closer and closer to Ganeshwadi. About a decade prior to research, the closest pool – just on the other side of the drainage ditch washed away enough dirt to leave the massive water main exposed. Plumbers quickly fixed pipelines (there are at least 40 1-inch pipes connected to this main at the edge of Ganeshwadi) to this 'very special pipe' a which yields water 24-hours a day (although midway through the research period the water began to dry out for a good portion of the afternoon). There were a number of theories about the origins of this pipe and the round-the-clock water inside it. My research in this neighborhood sought to understand not only the likelihood of these theories (although I did hope to discover when and why this pipe was laid, as well as how it was so productive), but to untangle the connections between various theories about the pipe, and the politics to which they give rise.

Method 7: Bringing the Work to the Water

The six methods of access that I have discussed thus far have in common that they involved the transportation of water from a source (even if a piped source), to a place of use. But this was not always the case; sometimes the use was brought to the water, as was very common in the case of laundry. Laundry is an extremely water-intensive activity, and has a special importance in what are often somewhat-muddy neighborhoods. School children emerge from narrow lanes, skipping over garbage-choked open sewers in incongruously crisp, clean uniforms. Low-income domestic workers stroll onto the grounds of shiny buildings and leafy bungalows looking fresh as dew in immaculately clean, pressed saris. For the city's lower-income office workers, policemen, teachers or politicians, laundry is the magic that preserves the invisible line between the filth of working- and middle-class neighborhoods, and the public face of a proud, confident, ambitious city. While much laundry work is encompassed in the previous six methods of access that I have described, I used laundry to study the work-to-water movement, which I observed at least three sites.

First, in Bhim Nagar, conflicts over water frequently found expression in scuffles about laundry: who is allowed to do their laundry how close to the pipe? The women from two or three families expressed their claims to authority over the pipes by squatting directly next to the pipe, filling their buckets and rinsing their clothes directly under the stream. Other women were prohibited from doing the same but some did anyway – and authority was often asserted, contested, and performed through doing laundry.

My second laundry-to-water fieldsite was a fishing village, where women traveled on foot from water-scarce neighborhoods all over the ward – mostly from Lallubhai and even Shivajinagar-Bainganwadi (a

good half-hour walk from the northern side of the railway tracks) – carrying their laundry for miles to wash clothes by the open well.

The last work-to-water movement that I studied mapped as that of commercial laundry. The M-East Ward was full of commercial laundries, but none of them did their washing on-site. Rather, I learned, these laundries collect the clothes from their customers, and send the loads by vehicle or bicycle to *dhobi ghats* (washing collectivities) around the city, doing only the ironing M-East ward. Many residents of neighborhoods relocated to M-East by urban development projects over the past few decades (see *Pipe Politics,* Chapters 2-3) originated in areas of Mumbai having large dhobi ghats: Mahalaxmi, for instance where a large number of Shivajinagar's original residents once lived; or more recently, the neighborhood of Kurla, where railway 'slumdwellers' were resettled in high-rise tenements as part of MUTP).[7] Mapping the work-to-water method of access allowed me to study the enduring nature of social and geographical ties and identities. This is the only aspect of my research that involved a formal survey. Since the information that I wanted was by-and-large straightforward – concerning customer base, pricing, and the location of the dhobi ghat to which the clothes were sent for washing – I hired a research team comprised of three young people to locate and survey each and every commercial laundry in the M-East Ward. The research team mapped and surveyed 77 laundries.

Method 8: Rain

While Mumbai's municipal water supply is sourced from surface water (lakes and rivers) hundreds of kilometers upstate, the city is also blessed (and cursed) with plentiful rain. According to the Government of Maharashtra (Division of Relief and Rehabilitation) (GOM 2011), Mumbai's average annual rainfall is 2146.6mm (84.5 inches), almost the entirety of which falls between mid-June and late August. While rapid concretization has famously led to catastrophic flooding during the rainy season (particularly in low-lying, reclaimed lands which are home to much of the city's working-class housing stock), enough of the monsoon plenty is absorbed into the city, where according to interviews with a Government of India Ministry of Water Resources engineer, the water table is replenished within a month of the rains' arrival. Given the deeply political character of water access in Mumbai, what happens when such plenty falls from the sky?

I studied rainwater from three fieldsites. The first was a verdant upper-middle class bungalow society (not, incidentally, the one where I lived) that contained two open wells (both of which were at ground level within three weeks of the onset of the 2009 monsoon). Frustrated with the increasingly intractable municipal water supply, the society had hired consultants to make recommendations about the possibility of harnessing and storing additional rainwater, perhaps even purifying it for potable uses. A second fieldsite is a gated community of high-rise luxury residential towers. By recent law, it had suddenly become mandatory that builders construct rainwater harvesting storage facilities in new constructions. This requirement was highly impracticable, however since (as explained in Interlude 4) the city's water table

[7] M-East Ward used to have a *dhobi ghat*, but in the past few years the land was acquired by a large golf club; the water is now used to water the green.

is so high that the maintenance staff has their hands full with drainage problems during the rain; storing additional water in the ground is either highly impractical or simply not possible. The third site from which I studied rainwater is a small 'slum' settlement situated on private, formerly agricultural land, adjacent to an unfinished well. While during most of the year the neighborhood has to transport potable water from a tap a 15-minute walk down the street (the well is fresh but not potable), during the rainy season families collect water in buckets and pots for use in cooking and bathing (generally they still get drinking water from the tap).

Conclusion: Access

Once I had identified my fieldsites, I had to figure out how to gain access to them. There were no guidelines or strategies that I could follow that would enable access to a fieldsite beyond basic common sense: the same laws of friendship and relationship apply in the context of 'the field' as in any other social situation; much of my 'fieldwork' had little to do with water, but comprised relationship forging and maintenance.

Given the vagaries of access, it was impossible to foresee which field sites might 'open up' and which would not. For example, I had initially presumed that my own housing society – Amar Gardens – would be easy enough to use as a fieldsite. But in the end it was one of the most closed and impenetrable, which proved to be a fascinating development in its own right. I continued to attempt to learn things from this site – to probe and negotiate… but I was never able to insinuate myself into that network of power relationships beyond my positionality as a 'paying guest' and a 'foreign researcher.' Plenty of neighbors were happy to invite me for tea, but the neighborhood's 'dirty laundry' was never openly aired in my presence. Over the period of research I continued to make efforts to access (and understand inaccess) to the sites that were persistently difficult. While these efforts did not always result in access, attending to *why* and *how* these hard-to-approach sites were so difficult to enter (and how these blockages could sometimes eventually overcome) proved a generative research practice in itself.

Conversely, I had assumed that the Municipal Corporation was going to be very difficult to access – I hadn't really planned to spend much time with city engineers because I presumed that the municipal bureaucracy would be opaque, closed, impenetrable. But once I made an effort to forge contacts, to make friends, and to figure out how I could make a connection, this fieldsite opened up and I was provided an remarkable level and ease of access. Indeed, once I had forged an initial a connection to one senior engineer the ball seemed to roll of its own accord. Even after that first engineer retired and no one knew how or why or by whom I had been given 'permission,' I had become such a regular feature of the water department that engineers and staff continued to be open and helpful.

Which is to say that access – in both its infrastructural and methodological senses – is often cumulative, leading to ever-greater access.

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