AQUEOUS TERRAINS AND THE WATER MANAGEMENT INFRASTRUCTURE: A NATURE-CULTURE PERSPECTIVE

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Abstract. 'Water inundation' is a phenomenological reality of aqueous terrains, such as river deltas, estuaries, floodplains, wetlands, marshes, and swamps. Since ancient Greek and Roman times, the practice of drain-and-fill and the resulting water management infrastructure have continuously drained these aqueous terrains, rejecting their fluidity. The practice continued through the medieval times, and later, through the European colonisation, and reached different parts of the globe. The Modern industrial capitalist culture observed this practice as a foundational infrastructure for establishing and expanding their cities in aqueous contexts. Such a denial has resulted in a substantial loss of these rich, bio-diverse ecosystems and in environmental degradation. Inquiring from a nature-culture perspective and taking a historical overview through a comprehensive literature review, this paper highlights four crucial aspects contributing to the legitimisation of the drain-and-fill practice and the imagining, design and planning of the water management infrastructure: firstly, the cultural pejoration of aqueous terrains and people associated with them; secondly, the imagining of cities as the antithesis of nature; thirdly, the lived experiences mediated through the preference for dry culture; fourthly, the traditional geographical concept of land and water and tools for surveying and map-making consolidated the first three aspects. For the sustainable design and planning of water management infrastructure, it is imperative to be aware of these four aspects, their dynamism in the process of imagining, and the mediating role they offer to the water management infrastructure. In today's challenging times of the ecological crisis and sea-level rise, this will potentially leverage a newer imagining of human habitation in aqueous terrains.

1. INTRODUCTION

'Water inundation' is a phenomenological reality of aqueous terrains such as river floodplains, estuaries, and deltas. Aqueous terrains also include a variety of fresh as well as saltwater wetlands in the shape of marshes, swamps, bogs, peatlands, fens, and mudflats, where land emerges from and submerges into water, daily as well as seasonally. These aqueous terrains with changing land-water situations have been characterised as wet, liminal, amphibious, ephemeral, temporal, and dynamic. In common parlance, 'wetlands' and 'aqueous terrains' point towards the same natural phenomenon, i.e., 'area made from, with, or by water' (Merriam-Webster Online Dictionary). In disciplinary parlance, the term 'wetlands' carries ecological and socio-economic meaning, and is defined as 'areas of land that are either covered by water or saturated with water' (National Geographic Society, 2023). The term 'aqueous terrain' carries geographical connotation for watery lands and is posed against the conventional concept of 'land' and 'water' in geography that have defined either entity in opposition to each other (Lahiri-Dutt, 2014). While their scientific acknowledgement as 'wetlands' by scientists is a recent phenomenon (National Research Council, 1995), their concept as 'aqueous terrains' (Mathur and Da Cunha, 2009) is an even more recent phenomenon. While the need to define wetlands scientifically has emerged from the conflict between socio-economic land-use planning and the ecological conservation of wetlands, the conceptualisation of 'aqueous terrains' was born out of a need to break away from the foundational land-water binary system in geography to leverage new imaginings of fluid environments of wetlands, especially due to

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the threats of global warming and sea-level rise. Importantly, the concept of 'aqueous terrains' acknowledges all waters (i.e., fresh and salt waters, surface, and subsoil waters), including rain, as a part of the same water continuum, thereby highlighting the interconnectedness of watery landscapes with their adjacent terrestrial and deep-water ecosystems.

The recent ecological and socio-economic acknowledgement of wetlands has identified them as crucial for human and societal well-being (Maltby, 2022), as well as for the sustenance of ecological biodiversity (Keddy, 2000). The major ecosystem services provided by them are: production (including wildlife production), the regulation of atmospheric carbon dioxide and methane levels, the maintenance of the global nitrogen cycle, the storage of ecological records, and flood reduction (Keddy, 2000). They rival tropical rainforests in biological abundance (Vileisis, 1997) and are critical to Earth's hydrological system (Keddy, 2000; Mitsche and Gosselink, 2015). The Ramsar Convention on Wetlands, Wetlands International, the International Union for Conservation of Nature (IUCN), and UNESCO have placed conservation and the management of wetlands as one of the important climate mitigation actions. But until recently, throughout human history, wetlands remained in disrepute, and their drainage and reclamation were justified. This has resulted in the substantial loss of this crucial ecosystem on a global scale (Matthews, 2013). Before investigating the reasons for their disrepute, drainage, reclamation, and the resulting water management infrastructure (WMI), it is important to undertake a historical overview of this practice and the resulting ecological concerns. This will help to understand why the nature-culture perspective was chosen for this inquiry, as well as comprehend its results (Fig. 1).

Fig. 1 – Aqueous Terrains of River Deltas.
Source: Sisser, 2015 (left & centre); Mukherjee, 2023 (right).

1.1. Human Inhabitation of Aqueous Terrains and a Historical Overview of the 'Drain-and-Fill' Practice

Over centuries, in spite of their fluid and dynamic character, many human civilisations have developed in aqueous terrains or on their periphery (Matthews, 2013), because of the extensive food chain and rich biodiversity that they support (Mitsche and Gosselink, 2015). The Nile River Delta in Egypt, in the river valley of Tigris and Euphrates in the Mesopotamia, West Asia, the Sundarbans Delta and the Bengal Delta of the rivers Ganges, Brahmaputra and Meghana, the Mekong River Delta in South-East Asia, the deltas of the rivers Rhine, Mass and Scheldt in North Europe, and the Mississippi River Delta in North America are some of the most densely populated areas in the world. Due to their accessibility by sea and inland waterways, many of the settlements in deltas and estuaries have

historically emerged as important centres of trade and industries, and many continue to be so even to this day. Mumbai, Kolkata, Dhaka, Ho Chi Minh City, Bangkok, Shanghai, Rotterdam, San Francisco, many of the German Hanseatic towns, and today's largest metropolitan region of the Pearl River Delta are such examples that continue to be the modern-day centres of trade and industry. Many of the medieval as well as modern-day cities, such as London, Paris, Berlin, Washington, New York, New Orleans, and Chicago, were built in and by inland aqueous terrains formed by river floodplains, marshes, and swamps (Giblett, 2016; Matthews, 2013).

The long history of human inhabitation of aqueous terrains displays two contradictory ways of their inhabitation – firstly, by accepting their fluidity, and secondly, by denying their fluid and dynamic character. The first approach is largely found in Asia, Africa, and South America, whereas the historical, as well as modern-day cities in Europe and North America, and most of the colonial and modern industrial cities across the globe are examples of the second approach. Historically, the first approach existed in parts of Europe, North America, and Mexico, but have ceased to exist today.

The second approach to the inhabitation of aqueous terrains is largely rooted in the drain-and-fill or dredge-and-fill practice and land reclamation, whose history could be traced back to the Late Middle Helladic Period (2nd Millennium BCE), when the Mycenaeans drained Lake Copais (or Kopais) and its marshes in Greece to reclaim land for agricultural purposes (Ghembaza and Windell, 2021). It was drained with the help of a hydraulic system composed of dams, dykes, and polders, diversion canals, sink holes, and deep-cut tunnels, eventually draining into the Gulf of Euboea (Ghembaza and Windell, 2021). The system collapsed, and the basin was catastrophically re-flooded during the Late Helladic IIIB period (Ghembaza and Windell, 2021). Attempts to re-drain the lake were made during the reign of Alexander the Great (335–331 BCE), and later under the Roman emperor Hadrian in the early 2nd century CE (Kokkinidis, 2025; Ghembaza and Windell, 2021). Alexander's Macedonia was built in the Axios marshes (Matthews, 2013). 'The Pontine Region Project' (started in 1987), an archaeological endeavour to study the long-term history of settlements and landscape in the Pontine region, has traced the history of the practice of draining and dredging of the Pontine marshes to around 300 BCE, when the Romans drained them to establish large agricultural areas. The marshes were drained through an intricate network of ditches and canals, with the main canal being *Decennovium* (Walsh *et al*., 2014; Tol and de Haas, 2020). The Roman towns and settlements, including the city of *Londinium*, built in Britain's landscape, comprised of rivers, streams, floodplains, bogs, marshes, fens, swamps, wet grasslands, carrs, and mudflats (Acreman and Jose, 2000, in Rogers, 2013) were also established through draining and land reclamation (Rogers, 2013). The Netherlands, a country located in the estuaries of the three rivers (Rhine, Maas, and Scheldt), also has most of its land reclaimed and created by draining and dredging these estuaries and parts of the North Sea (Waterman *et al.*, 1998). Since the 10th century, gradual draining of the low-lying *komgronden* (back swamps) had started with the help of windmills and the construction of dykes (Oosthoek, 2006). This system of land reclamation is called the *polder system* (Oosthoek, 2006). To protect reclaimed lands from flooding, dykes were built along the rivers; wherever necessary, river courses were diverted, reversed, channelised, and dredged (Oosthoek, 2006; Hoeksema, 2007). Today, the country's urban and rural landscape is a heavily controlled, vast, and complex network of river channels, canals, drains, dykes, levees, check-gates, valves, and surge barriers (van de Ven, 2004; Oosthoek, 2006; Hoeksema, 2007). Other European cities, such as Berlin, Paris, Hamburg, and St. Petersburg, were also built in swampy and marshy landscapes (Giblett, 2016). During the 16th, 17th and 18th centuries, the drain-and-fill practice resulted in a successful business model for the Dutch engineers and entrepreneurs, who popularised this practice amongst the European rulers and elites (Morera, 2010; Blackbourn, n.d.). For the European colonisers and elites, land reclamation was a means of expanding their territories, of taking control over bigger resources, and of generating more revenue (Morera, 2010; Blackbourn, n.d.). This period saw large-scale drainage projects across Europe, such as the draining of the Fens in England (Ash, 2017), the draining of France's inland and costal lakes, marshes, and swamps by the French monarchy (Morera, 2010), and the draining of Prussian moors,

marshes, swamps, and fens by the German colonists (Blackbourn, n.d.), to name but a few. The European colonisers exploited this practice for the establishment of their endo-colonial cities, such as Chicago, Boston, New York, Washington, and New Orleans in the North America, Christchurch in New Zealand (Giblette, 2016; Mitsch and Gosselink, 2015), and their colonial cities in other parts of the world such as Bombay (Mumbai), Calcutta (Kolkata), Madras (Chennai), Dhaka, Batavia (Jakarta), and Mexico. While New Orleans relied on drainage pumps for draining the swampy landscape of the Lower Mississippi delta (Dunn, 2020), Chicago deployed a complex system of river channel reversals and total alteration of the natural topography of its region (Hill, 2000). The city of Bombay was built by reclaiming the land from the Arabian Sea in-between the Bombay Islands, by constructing causeways, embankments, filling tidal flats, and through shoreline expansions (Riding, 2018). While the British built the city of Bombay, a completely new city off the western coast of India, the Spanish built the city of Mexico on the Aztec capital city of Tenochtitlan, by demolishing it and by draining and filling Lake Texcoco and a few other lakes in the Mexico valley (Montero-Rosado *et al*., 2022). The 19th and 20th centuries' modern industrial cities increasingly recognised the drain-and-fill practice as a foundational infrastructure for their establishment and expansion in the context of aqueous terrains. Large scale costal land reclamations done in the USA, UK, Netherlands, Singapore, Japan, South Korea, and China, especially during the 19th and 20th centuries, to create more land for agriculture, industrialisation, and urban expansion (Stauber *et al.*, 2016; Xu *et al.*, 2021; Meng *et al.* 2017 and Hoeksema, 2007 in Yan *et al.*, 2023) only indicate the spread and legitimisation of the drain-and-fill practice across the globe. These two centuries also saw the final drainage of some of the aqueous terrains, which were being drained continuously over a long period of time. For example, Lake Copais in Greece was drained in the late 19th century (Ghembaza and Windell, 2021), Lake Texcoco was drained in 1910 (Montero-Rosado *et al.*, 2022), and the Pontine marshes were fully drained and reclaimed in the 1930s (Grupusso, 2022).

The practice of drain-and-fill has contributed largely to the evolution and advancement of hydraulic engineering and water drainage and control infrastructure, shaping its components such as embankments, dykes, causeways, ditches, drainage channels, canals, bypass floodways, spillways, check gates, sluice gates, locks, tidal gates, surge barriers, windmills, drainage pumps, pumping stations, and dams. All these components and their networks, in their simplicity and complexity, are always intended to 'separate land from water' and 'protect reclaimed land from inundation'. Thus, the artificial ground built for human habitation by the drain-and-fill practice is a heavily engineered ground devoid of any traces of its past fluid landscape and persistently vulnerable to inundation and subsidence, demanding a further concrete division between land and water and an advanced control over water.

1.2. Ecological Degradation and Challenges to Cities

It is important to note that the drain-and-fill practice used for urban and rural planning displays the attitude of alteration, control, and regulation of the natural hydrological systems through heavy technological interventions. Such an approach to water management has resulted in the draining and dredging of wetlands, swamps, and marshes, the emptying of lakes, and the straightening, channelisation, and reversal of river courses outside their own basins, irrespective of their size, shape, and type. This has resulted in a complete alteration of natural aqueous terrains, their dependent terrestrial and deepwater ecosystems, the hydrological cycle, and, at times, the total erasure of aqueous terrains, as well.

In reasoning the higher global loss of aqueous terrains, Mitsch and Gosselink (2015) have marked the dominance of the drain-and-fill approach globally. The reported long-term global loss of natural wetlands averages between 54–57% but may have been as high as 87% since 1700 CE (Davidson, 2014). The global rate of loss has been 3.7 times faster in the 20th and 21st centuries than in past centuries, with a loss of 64–71% of wetlands since 1900 CE (Davidson, 2014). The Ramsar Convention on Wetlands' 2018 report has flagged the significant loss of wetlands during the 19th and 20th centuries. Over four

decades, between 1970 to 2005, a 35% loss in global wetlands was observed. This is a three-times more intense loss than forest loss (Ramsar Convention, 2018). Regional studies on wetland losses bring forth a more critical picture. Starting from the European colonisation of the USA, i.e., from 1600 to the mid-1980s, it has lost about 50% of its wetlands to drainage, with six states losing more than 85% of their wetland acreage (Dahl, 1990 and Dahl and Johnson, 1991 in Dahl and Allord, n.d.). Between 1700 and 2020, Europe has substantially lost its wetlands, with Ireland losing more than 90%, Germany, Lithuania, and Hungary more than 80%, and the UK, the Netherlands and Italy more than 75% (Fluet-Chouinard, 2023). Since the 1950s, China is estimated to have lost about 51% of its coastal wetlands to land reclamation (Wang *et al*., 2014; An *et al.*, 2007; An *et al.*, 2007 in Stauber *et al*., 2016). These are some of the figures indicating the loss of wetlands in the past three centuries for which data is available.

Such a loss in wetlands has cascaded into multiple ecological and environmental problems on a global scale. The Ramsar Convention on Wetlands' 2018 report has marked the decline, since 1970, of 81% of the inland wetland species population and 36% of coastal and marine species. Over 30% of wetland species globally are threatened. The extinction risk for many of the wetland flora and fauna species is increasing. The pollution of these wetlands, due to the draining of sewage and industrial waste, is an additional threat (Ramsar Convention, 2018). Wetland loss has strongly affected the greenhouse gas fluxes, flood control, nutrient cycling, and biodiversity (Zedler and Kercher, 2005, and Finlayson, 2005 in Fluet-Chouinard *et al.*, 2023). Local and regional implications of wetland loss are more critical. The mechanical taming of the entire Mississippi River system (Day *et al*., 2024) has caused the collapse of its delta through substantial land loss, especially in this and the previous centuries (Blum *et al*., 2023; Restore the Mississippi River Delta, 2025). Many of the species of birds and fish that once flourished around Tenochtitlan (present-day Mexico City) are now extinct (Ponsford, 2023). Land reclamation and sea wall construction in China have led to the degradation of the remaining aqueous terrains due to a reduced water storage capacity, a loss in carbon storage capacity, water pollution, and biological invasion, altogether negatively affecting the ecological services of wetlands (An *et al*., 2007; Chou *et al*., 2019). The cascading effects on their adjacent terrestrial and deep-water ecosystems are largely unknown.

Aqueous terrains such as wetlands, marshes, or swamps are the natural sponges that allow for water absorption and act as natural barriers against flooding (Ramsar Convention, 2018). But the practice of drain-and-fill has proved detrimental to the very existence of cities and human settlements, as it has compromised the very natural defence. The devastation that flooded 80% of the city of New Orleans, causing damages of $125 billion (Murphy, 2005), 'the costliest natural disaster in the history of the USA' (Center, 2018), was due to the heavy alteration made in the overall riverine system of the Mississippi River (Giblett, 2016). In general, the histories of building cities in aqueous terrains are also the histories of their continued struggle with flooding and subsidence. Despite raising the city of Chicago, including its buildings, by almost 8-10 feet during the Chesbrough Underground Sewer Project (1855 CE) to keep the city from sinking and free of swampy conditions, it had to undergo the massive Deep Tunnel Project (1990s onwards) to avoid further sinking and flooding (Salzmann, 2018). Given the prolonged and controlled ingress of water in their larger delta and lagoon regions, Amsterdam and Venice are facing the problem of subsidence, which causes instability in the very foundations of these cities (Hoeksema, 2007; Crass, 2022; Brambati *et al*., 2003). In modern-day Mexico City, apart from the variegated subsidence, the acute shortage of drinking water has resulted in the socio-economic issue of compromised women's participation in the formal workforce (Montero-Rosado *et al*., 2022; Bosch *et al*., 2021). Every year, the city of Mumbai suffers floods during the monsoon rains, causing major disruption of essential services such as electricity, water supply, communication networks, and transportation (Mathur and Da Cunha, 2009). In particular, the coastal cities are currently facing the additional threat of subsidence due to a rise in sea level. Such persistent vulnerability has rather led to a

more advanced and efficient defence mechanism to keep the water away. For example, the two grand-scale, flood-control projects, the Barrier Dam project at Zuiderzee (started in the 1930s) and the Delta Works Project of storm surge barriers (started in 1953), were built to keep the North Sea from entering the delta region within which the entire country of the Netherlands is situated (Hoeksema, 2007; Oosthoek, 2006). To name a few, other such projects are the Thames Barrier in London (GOV-UK, 2025) and MOSE (Experimental Electromechanical Module) in Venice (Keith, 2019; Kolbus, 2019).

While the drain-and-fill practice has not only made the cities built in aqueous terrains perpetually vulnerable, but it has also triggered serious damage to the hydrological system of the Earth.

So, it becomes imperative to understand the reasons contributing to the creation of the drain-and-fill practice, its eventual legitimisation, and the resulting WMI, especially when we, as a global society, are aspiring towards sustainable development. As a matter of infrastructure, this practice has always been investigated from the technological and economic concerns of efficiency and productivity in separating land and water. Such a technological perspective has constrained our understanding of the very imagining of such a practice and the ability to design and plan the WMI and, in turn, human habitation in the context of aqueous terrains. Mosse (2008) has argued, especially when talking about the emerging 'water crises', that the problems associated with water can't be tackled within the confines of economy, hydrology, and engineering sciences, but require a wider cultural and historical perspective. The drain-and-fill practice and the resulting WMI are indeed a part of this emerging 'water crises'. Thus, this paper attempts to investigate the contributing aspects to the imagining of the drain-and-fill practice and the resulting WMI by adopting a cultural and historical perspective, namely, a nature-culture perspective.

2. METHODOLOGY

Considering sustainability demands a shift from the anthropocentric worldview to an ecological worldview. The ecological worldview in all its variants (as it is still under consolidation) underscores the interconnectedness of all living beings and their environments, including that of humans. The nature-culture perspective facilitates this transition by bringing out how nature and culture shape each other while providing a better understanding of the formation of the nature/culture dichotomy as embedded in the anthropocentric worldview. It has enabled an interdisciplinary and multidisciplinary understanding of how nature and culture (human beings) influence each other, revealing the complexity of their connections, filling in the gap between the traditional academic extremities of 'nature nurtures culture' vs. 'culture nurtures nature'. To mark the differences in approach to aqueous terrains, Dugan (1998) has introduced the concept of 'hydraulic' and 'aquatic' civilisations. As per his observation, 'hydraulic' civilisations are European in origin and have controlled water flow through dams, dykes, pumps, and drainage canals. Whereas 'aquatic' civilisations are Asian in origin and have adapted to the pulsating character of watery terrains of floodplains and deltas, such as annual/seasonal flooding (Mitsch and Gosselink, 2015). These observations and distinctions are critical to this inquiry of understanding the imagining of the drain-and-fill practice and the resulting WMI. It rather supports the nature-culture perspective, as this perspective engages with both natural and cultural aspects, contributing to human cognition, the formulation of meanings, values, and attitudes, and the resulting actions. Imagining, here, refers to the process of consolidating ideas, meanings, and symbols that eventually manifest as human actions.

Therefore, to conduct such an inquiry, especially where the practice of drain-and-fill and the resulting WMI have a long history of about 4000 years, this paper, through a comprehensive literature review, takes a historical overview of how aqueous terrains and water, in general, were perceived by the cultures that promoted this practice. It also engages in understanding their relationship with nature and their concept of the city, as these two aspects contribute to shaping urban structure, urban patterns, and

urban forms. As the WMI is foundational to the city-building process in aqueous terrains, providing the city with its structure, the perception of landscape and the concept of city are both critical to the imagining of the WMI.

The cultures investigated here are the Greek, Roman, medieval European, colonial European, modern and contemporary industrial cultures, as these cultures and societies justified the drain-and-fill practice and the resulting WMI. Understanding their perception of aqueous terrains is established from the already published research and books on environmental cultural studies, history, geography, ecology, anthropology, and wetland archaeology. Wherever necessary, it has also referred to studies on the philosophies of these societies to understand their worldview, to know about their portrayal of reality within which the human-nature connection is articulated. To understand their ideas and the concept of human habitation (city), the already published research, books, and works on history and theory of city/urban planning, architecture, landscape, and landscape archaeology are referred to. Land survey and map-making are critical to urban planning and architecture, being the methods of measurement and representation of the surface of the earth and its components; they might have contributed to the imagining of aqueous terrains and the concept of city for these cultures. So apart from histories and theories of city planning and architecture, the tool of map-making is also investigated. Eventually, all the information and observations are collated to trace the aspect/s critical to the imagining of drain-and-fill practice and the resulting WMI.

3. RESULTS AND DISCUSSION

From the historical overview carried out through a comprehensive literature review, the following four aspects are observed as influencing the imagining of the drain-and-fill practice and the resulting WMI.

3.1. The Cultural Pejoration of Aqueous Terrains

Be it by the Greeks, the Romans, the medieval and post-medieval European imperialism, or by the modern industrial-capitalist society, aqueous terrains were perceived as obstacles for the development of any human habitation (Matthews, 2013; Goblett, 2016), and this perception was driven by the cultural pejoration of these terrains having no economic value.

Although it is difficult to locate the exact origin, the cultural pejoration of aqueous terrains (especially of wetlands, swamps, and marshes) can be traced back to classical Greek times (Giblett, 2016). In the myth of the sixth Herculean labour of killing the monstrous Stymphalian birds that lived in the marsh, the early cultural pejoration of marshes can be found, since they are regarded as the breeding grounds of monstrous creatures (Hawes, 2017; Giblett, 2016). In the foundational events of Christianity, the act of destroying swamps and marshes, their draining and filling, was seen as a divine mission and a sacred trust, as they saw swamps as hell on earth (Giblett, 2016). Vitruvius, a late Roman Republican military engineer and architect, had identified marshes and swamps in his seminal treatise on architecture – 'The Ten Books on Architecture' (1st century BCE), as the unfit and unhealthy sites for establishing towns and cities (Pollio, 1914). With regards to the Pontine marshes that were first drained by the Romans, Vitruvius had written, "when the marshes are stagnant, and have no drainage by means of rivers or drains, as is the case with the Pontine marshes, they become putrid, and emit vapours of a heavy and pestilent nature" (Tol and Haas, 2020). Although Romans had a ritualistic relationship with rivers, lakes, and springs, their approach to landscape and cityscape was to create highly ordered and monumental environments (Rogers, 2013; Kostof, 1995). Within such an ordered and monumental imagining of landscape, rivers, lakes, and springs were also organised geometrically for their aesthetic and practical value by means of channelisation, redirecting their courses, and

symbolically incorporating them in the larger, artificially altered, monumental landscapes. But wetlands, floodplains, swamps, and marshes were incorporated in these monumental landscapes through their drainage and land reclamation (Rogers, 2013). Such an approach to the heavy alteration of nature, be it land or waterscape, was in line with the Greco-Roman worldview, according to which 'the natural world was created to provide for humankind' (Robertson and Pollaro, 2022). This worldview noted that humanity is 'a higher-order life form that had natural dominion over all the organisms and hence fully warranted to utilise its authority for its personal gain' (Robertson and Pollaro, 2022). Nature was believed not to be respected as something peaceful, but to be conquered and used (Robertson and Pollaro, 2022). Many of the Greek and Roman traditions of philosophy, science, religion, and ecology shared this attitude (Robertson and Pollaro, 2022; Thommen, 2009).

Fig. 2 – La Malaria (c.1850) by Ernest Hébert.
Source: Wikimedia Commons.

The cultural pejoration of aqueous terrains as distress realms, breeding grounds for diseases and hindrances to any positive development continued throughout the medieval and post-medieval times, as well. Additionally, people who lived there were held in contempt as pariahs (Matthews, 2013). This period saw some large-scale drainage projects in different parts of Europe to 'improve' and 'rationalise' land (Rogers, 2013). Draining 'barbarous' aqueous terrains was seen as an act of 'taming' 'wild' nature by making it 'useful' (Blackbourn, n.d.). Many projects were supported by churches, and some devised stories demonising aqueous terrains in justification of their drainage, such as in the case of the drainage of Romney Marsh in England and the story of Guthlac's trial (Calzadilla and Witteman, 2024). The *Miasma* theory that had portrayed swamps, marshes, and wetlands as breeding grounds for 'miasma' since the classical Greek and Roman times, continued throughout these periods, up to the middle of the 19th century (Giblett, 2016; Kannadan, 2018). The Miasma theory was first proposed by the Greek physician Hippocrates (460-377 BCE), who believed that the fatal epidemics such as those of cholera and malaria were due to bad air (Kannadan, 2018). Interestingly, the *Italian* term '*mal'aria*', meaning 'bad air', referred to the 'dense exhalation of foul air coming from the Pontine marshes' that was believed to spread pestilence in Rome and beyond in medieval times (Zeldovich, 2020). With the

European colonisation across the globe, the *Miasma* theory also spread to said colonies, prompting many of the drainage projects under the pretext of 'cleaning up the environment' for sanitation and public health (Cleetus, 2020; Crawford, 2020).

With the establishment of the drain-and-fill practice of land reclamation into a model practice as well as a successful Dutch business model supported by the European rulers and elites during the 16th, 17th, and 18th centuries (Morera, 2010; Blackbourn, n.d.), cultural pejoration of aqueous terrains was coupled with the elitist, exploitative gaze. This period not only saw aqueous terrains as 'barbarous', 'wild', 'savage', 'primitive land' (Blackbourn, n.d.), but also strengthened the already existing wasteful/ useful dichotomy in Western thought (Blackbourn, n.d.; Pournelle, 2003). In the aspiration to take control over larger resources and to increase revenue, this dichotomy became the major driving force for most of the drainage projects of aqueous terrains in the European colonies across Asia, Africa, and Latin America, as well as in North America (Pournelle, 2003). Throughout Western enlightenment, both the cultural pejoration and the elitist exploitative gaze received renewed momentum from Cartesianism and the enlightened absolutism. The justification for the human alteration of nature during this period was that man, "the lord and master of nature" (in Descartes' words), has a right and duty to 'repair' or 'improve' *natura lapsa* (Blackbourn, n.d.). In support of the elitist perspective, writers on natural history of the 17th and 18th centuries rendered marshes and swamps as dark, disorderly corners of nature where animal bodies decayed, emitting noxious-smelling and unhealthy miasma (Blackbourn, n.d.). A unanimous agreement on the draining of swamps, marshes and wetlands was observed among the European rulers and elite during this period, unlike on any other matter (Blackbourn, n.d.). In the USA, drainage and land reclamation received legal support, as in the case of the Swamp Land Act of 1850, which allowed reclamation of swamplands for agricultural purposes and the development of settlements. Here, the Federal Government undertook the majority of the wetland drainage projects with the help of the US Army Corp of Engineers (National Research Council, 1995).

In the 19th and 20th centuries, modern industrial capitalism superimposed its utilitarian and functional perspective onto the already present wasteful/useful dichotomy through the idea of 'land use', an important tool of modern urban planning. Given the growing demand for land for the growth of industries and cities, the drain-and-fill practice was justified through the tool of land use that identified wetlands, swamps, and marshes as 'wastelands'. In the middle of the 19th century, a new revolutionary 'germ theory', which stated that 'pathogenic microorganisms are responsible for causing infectious diseases' (Carlsson and Raberg, 2024), proved the age-old 'miasma theory' to be redundant (Kannadan, 2018). Still, the dismissal of the miasma theory didn't improve the image of wetlands, marshes, and swamps as breeding grounds of disease, and their drainage continued under the "Great Sanitary Awakening" (Winslow, 1923; Institute of Medicine, 1988).

Being both land and water, having liminality and being recognised as 'wasteland', they were often encroached by poor, landless migrants forming slums and shanties. For example, Dharavi in Mumbai (India), recognised as the largest slum in Asia (World Population Review, 2024 in Goyal and Lima, 2024), grew in the swampy mangrove at the mouth of the Mithi River where it drains into Mahim creek (Goyal and Lima, 2024). While industrialisation abused aqueous terrains by declaring them 'wastelands' and often turning them into dumping grounds of city and industrial waste (Giblett, 2016), their cultural pejoration continued during this period through literature and popular culture (Giblett, 2016). Rendering of aqueous terrains and their inhabitants as sinister and forbidding is common in the popular media of cinema, and very visible in Hollywood films (Giblett, 2016; Mitsche and Gosselink, 2007). The portrayal of Dharavi and other slums developed in Mumbai's coastal marshy lands as the city's underbelly and the underworld could be observed in many Bollywood films. The denigration of aqueous terrains and the people associated with them is not a modern phenomenon; it was there in the past, too. For example, indigenous communities residing in Prussian swamps and marshes were referred to as 'barbarous', 'ignorant', 'superstitious', and 'backwards' by Frederick the Great when major projects of draining swamps and marshes were undertaken by the German colonists in the 17th and 18th centuries

(Blackbourn, n.d.). Much before this, in the 16th century, the indigenous Aztec people of Tenochtitlan were portrayed as 'barbaric' by the Spanish conquistadors in their justification for taking over the city and its consequent demolition (Mundy, 1998).

The 20th century continued the trajectory of cultural pejoration. "If you want to get rid of mosquitoes, drain the swamp that breeds them" (1909, Library of Congress) (Fig. 3), a famous slogan or a simple phrase, 'drain the swamp', is mired in the American political discourse (Abbott, 2017). This phrase is used quite often by American politicians and activists, pointing at their intentions to eradicate institutions or various agents of corruption and harmful political and economic ideologies, and to remove larger contexts (referred to as swamps) that supposedly 'breed' such agents (Myers, 2024). Although leftist in its origin, the phrase has journeyed into the 21st century through Donald Trump's electoral campaign of 2016 (Myers, 2024). The grand project of drainage, land reclamation, and urbanisation of the Pontine Marshes (1930–1939) was an important national project for Mussolini's fascist regime (Caprotti, 2007). It was heavily promoted and publicised as a national metaphor for Mussolini's drive to modernise and build a new Italy (Caprotti, 2007; Gautheret, 2022). In his accusation of the *Marsh Arabs*, the inhabitants of the Mesopotamian marshes, of treachery against Iraq during the Iran-Iraq war of 1980-1988, Saddam Hussein (then president of Iraq) had dammed and drained the marshes in the 1990s to force out the rebels hiding in the reeds (World Water Atlas, 2025).

Fig. 3 – If you want to get rid of mosquitoes, drain the swamp that breeds them (c.1909) by Udo J.Keppler. *Source:* Library of Congress.

Somewhat developed during the classical Greek and Roman times, the trope of denigration of aqueous terrains such as wetlands, swamps, marshes, bogs, peatlands, floodplains, and the people associated with them, has found newer forms of expression through time. The trope is observed to be renewed in time and again through myths, religious divine actions, language, literature, natural sciences, medical theories, popular culture, the political and elitist desire for discipline, rule and control, and exploitative economic interests. This has led to the cultural pejoration of aqueous terrains in time. This trope is deeply rooted in the worldview of the human/nature dichotomy, where man is thought to be the superior being when compared to any other beings in nature. Indirectly, it has valorised land to the detriment of water.

3.2. The Image and Imagining of a City

The imagining of man as 'the lord and master of nature' and the cultural pejoration of aqueous terrains could be observed to be driving the very imagining of a city built in the context of these terrains.

Vitruvius, in his treatise on architecture (1st century BCE), explained the principles of locating an appropriate site for the construction of fortified towns as "… such a site will be high, neither misty nor frosty, and in a climate neither hot nor cold, but temperate; further, without marshes in the neighbourhood. For when the morning breezes blow towards the town at sunrise, if they bring with them mists from marshes and, mingled with mist, the poisonous breath of the creatures of the marshes to be wafted into the bodies of the inhabitants, they will make the site unhealthy. …" (Pollio, 1914). In this judgement by the master architect, the cultural pejoration of aqueous terrains received professional justification during the classical Roman times. Following such a professional assertion, cities built by draining aqueous terrains were also in accordance with the Roman city planning principles of orthogonal grid-iron layout and monumental architecture. The Romans were technically sound, skilled engineers, and aggressive city builders (Gallion and Eisner, 2003). Their aggressive approach is visible in the large-scale alterations made in their natural environments for building their cities in the Mediterranean region and Roman colonies across Europe through the system of *centuriation* (Rogers, 2013). Within the Roman hegemonic worldview, the coupling of the demonisation of aqueous terrains and the valorisation of cities is observed (Gruppuso, 2022), forming one of the early dichotomous portrayals of nature vs cities. "In the beginning, there was marshy fluidity, where land and water were confused in a murky and fluid primordial soup. In this context, there is neither solidity nor liquidness; it is for God, the Maker, to create both solid surfaces and flowing water, by separating out the former to leave the latter as its residue. This original land reclamation allows God to generate life" (Gruppuso, 2022). For the Christian philosophers and city theologians, "the ideal city" was a divine right, a means towards alignment with the laws of God, and the destruction and draining of swamps and marshes was a divine mission and a sacred trust (Giblett, 2016; London, 2023). Both, a divine right and a sacred act, complemented each other in the biblical myth of creation, in the human aspiration to align with the laws of God.

Although the classical Roman Empire fell, the dominance of the church as a city's anchoring institution continued throughout the medieval times. That must have propagated the idea of a divine right and the sacred mission of draining aqueous terrains. This is evident from the drainage projects conducted during the medieval times across Europe, for agricultural purposes and the establishment of settlements, and not only for building cities. Such projects were supported by churches, monasteries, and monarchs alike (Giblett, 2016; Rogers, 2013; Calzadilla and Witteman, 2024).

In the process of reviving the classical Greek and Roman principles of architecture and city planning, the Renaissance architects and city builders regarded Vitruvius as the master architect and drew their theories and practices based on his treatise, *De Architectura*, regarding it as the foundational text (Anderson, 2013; Fletcher, 1943). The Renaissance city was a highly ordered city, characterised by symmetry, strong axial planning, and monumental scale. The painting "The Ideal City" (c.1480-1484), by Italian artist Giuliano da Sangallo, epitomised all the principles of Renaissance city planning (Fig. 4) (The Walters Art Museum, n.d.). Such an ordered city stood in contrast to the wild nature and fuzzy fluid aqueous terrains. During this period, "the progress in mathematics and the rediscovery of the Greek works which relate to harmony and proportions led many to conceive of architecture as a model for Reason, a victory over chaos, a victory of demiurgic man over natural elements; the same could be said of urban planning as well as of the architecture of gardens" (The Spirit of the Eye, 2021). The Renaissance city also dealt with the concerns of medieval cities, such as overcrowding, congestion, frequent epidemics, public security, and defence (Gallion and Eisner, 2003; The Spirit of the Eye, 2021). Thus, city planning treatises of this period also tackled such political and social concerns (Gallion and Eisner, 2003). Together, the Renaissance ideals could be observed to be well represented in Leonardo da Vinci's "Vitruvian Man" (c. 1498) (Fig. 5), that was partially drawn upon the proportion theories of Vitruvius (Baugh, 2025). This figure has been recurrently used to demonstrate the Renaissance idea of

man as a symbolic microcosm, thus praising his role as the centre of the universe (Murtinho, 2015) and expressing confidence in his virtues, his capacity to build cities in accordance with reason (The Spirit of the Eye, 2021). The baroque cities of the 17th and the early 18th centuries intensified the city's order and monumentality with their spaces of unparalleled proportions and scale of incomprehensible size (Gallion and Eisner, 2003). Baroque cities and Baroque gardens both shared the principles of imposition of grand, geometrical order upon nature. The grandeur reflected the ruler's ego, dominance, and new wealth acquired from the colonial expansion to other continents (Gallion and Eisner, 2003). This was the period that saw drain-and-fill practice and land reclamation turn into a successful Dutch business model. Following in the footsteps of the Dutch business model, ideas of Renaissance, Baroque, and Neoclassical cities, and their principle of imposition of geometric order upon nature, also reached the colonies. Early American cities, such as Chicago, Washington D.C., and New York, are some examples of such an imposition onto their pre-existing aqueous terrains.

Fig. 4 – The Ideal City (c.1480-1484) by Giuliano da Sangallo.
Source: Wikimedia Commons.

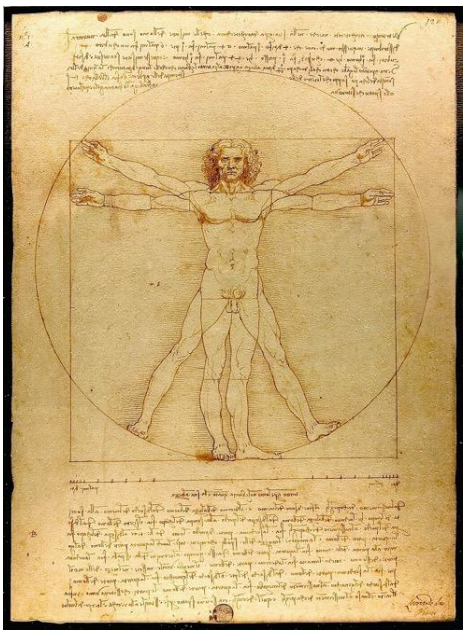

Fig. 5 – The Vitruvian Man (c.1498) by Leonardo da Vinci.
Source: Wikimedia Commons.

With the industrial revolution, the idea of a city and its imagining started anchoring itself into the mechanistic worldview brought by industrialisation. In the late 19th and early 20th centuries, the increasing problems of population growth, demand for city expansion, and environmental pollution of the early industrial cities forced a change in the way cities were planned and built (Gallion and Eisner, 2003). The industrial capitalist city was necessarily a city meant for commerce and trade, with the manufacturing and exchange of industrial products at its heart. The functioning of these activities needed institutions managing them, and physical infrastructure such as transportation, water supply, and drainage to support them. To respond to the complexity of the industrial city, urban planning emerged as a specialised profession to be practised by expert "city engineers" having the necessary knowledge and skillsets, and planning boards were established (Gallion and Eisner, 2003). While functional zoning emerged as a primary principle of master planning, land-use became its primary tool. Urban planning became an engineering process geared towards achieving 'development' and 'progress'. Within the modern urban planning perspective, the city is a social, economic, political, and technological entity rooted in the principles of functionality, productivity, and efficiency. Various urban planning theories and discourses which emerged in the 20th century have this perspective on cities. These principles and the mechanistic worldview brought by industrialisation are best reflected in Le Corbusier's articulation of the "city as a machine for living" (Corbusier, 1931). In another expression of the city/nature dichotomy, the modern industrial city gave rise to a dichotomy of "city and region", where the region was subservient to the city (Rodrigue, 2024). Similar to nature, water was also treated as being subservient to the city in the form of the infrastructure of water supply, its drainage, and, whenever possible, its use for navigation. Once again, water was regarded through the engineering lens. With the development of hydraulic engineering and the corresponding technological advancements, the drain-and-fill practice became efficient. This resulted in the final draining of some of the prolonged drainage projects in the 20th century, as discussed before.

Starting from the Roman classical times, the imagining of a city has always been the antithesis of nature. So, within this trajectory, rarely any other approaches to the city were established in the context of aqueous terrains. Additionally, such an imagining of the city guaranteed rulers, monarchs, the elite, capitalists, technocrats, as well as city planners and designers, promise to write down heroic narratives of "victory over nature" and the "city as the greatest creation of mankind". This only strengthened the trope of human superiority over other species on Earth. With the imposition of geometric order, not only on the fuzzy, fluid aqueous terrains, but also on nature, the imagining of the city was always anchored into *terra-firma* (dry, stable land) and against *aqua-fluxus.* This led to a culture with a preference for dry-land conditions, further adding to the perception that "what is wet is a sign of backwardness and archaic practices" (Ashraf, 2014).

3.3. Lived Experiences of Aqueous Terrains

Although it is difficult to draw a conclusion regarding the early lived experiences of aqueous terrains and whether they shaped the ancient Greco-Roman cultural attitude towards these terrains or whether it was the other way around, what is certain is that lived experiences and cultural values do influence and shape each other.

Perhaps, an observation of the seasonal fluctuation in the water level of the Lake Copais, caused naturally by the sinkhole (*katavothre*s – natural cracks in the *karstic* limestone) geography of the surrounding terrain (Ghembaza and Windell, 2021; Hawes, 2017) might have prompted and inspired the early Mycenaeans to imagine the large hydraulic system to drain the lake through a deeply cut channel (Hawes, 2017). Though debatable whether it be history or myth, there exists a story of the flood of Ogyges, a primordial/indigenous ruler of the Attica and Boeotia regions where the Lake Copais is located, that refers to a flood inundating both regions during his reign (Ghembaza and Windell, 2021). There are also studies showing that the Lake Copais and its marshes have changed their span and

appearance several times in ancient times (Ghembaza and Windell, 2021). Although it is unclear whether the three aspects influenced each other, the lived experiences of the *karstic* limestone geography with *katavothre*s and the Lake Copais, characterised by seasonal and frequent events of inundation, the early drainage work through an elaborate hydraulic system by the Mycenaeans, and the myth of the flood of Ogyges, do exist next to each other. But its final drainage that was carried out in the first half of the 19th century was prompted by the demand from the inhabitants of this region who saw the lake and its marshes as unhealthy in the summers and flooded in winters (Ghembaza and Windell, 2021).

During the late Republican Roman Period, settlements and agricultural activities in the Pontine marshes were declining (de Haas, 2017), especially from the 2nd century BCE onwards, when the abandonment process started. By the 1st and 2nd centuries CE, very few settlements remained in the region (de Haas, 2017). The lack of maintenance and the draining of land itself might have deteriorated the landscape, infesting it with mosquitoes (de Haas, 2017). This period coincides with the Roman poet Horace's night stay (38 BCE) at a waystation of *Forum Appi*, which he found to be a nightmarish experience due to the unpleasant water conditions, the latter being infested with mosquitoes and frogs (Tol and de Haas, 2020). Coinciding with this period, Vitruvius's (the 1st century BCE) derogatory rendering of marshes as places breeding miasma must have been based on these degraded conditions of the Pontine marshes. But Vitruvius's rendering eventually became one of the grounding principles for urban planning and architecture.

Similarly, the lived experiences of the degraded conditions of the medieval cities, due to over-crowding, congestion, poor sanitation, and waste disposal provisions (Gallion and Eisner, 2003), might have led to the derogatory renderings, as well as the eradication of aqueous terrains during this period, especially in the case of those cities and towns established in such contexts. Such a connection between the lived experience of degraded city conditions and the derogatory rendering of aqueous terrains also existed in the early industrial cities in Europe and their colonies across the globe. In 17th-century Bombay, the high mortality rate of Europeans was an immediate concern that eventually became the pretext for the 'public health' narrative and an important motivation for later land reclamation projects (Riding, 2018). In the 19th century, 'swampy' Chicago faced a series of epidemics of cholera, typhoid, and dysentery due to unhygienic conditions in the city, caused by dumping city waste, including human and animal waste, into the Chicago River, that used to empty into the Lake Michigan, the source of the city's drinking water, polluting it (Salzmann, 2018). The situation is described as 'the river had turned into a toxic wasteland and its stench could make people sick' (Stone, 2024). To mitigate this situation, the Chesbrough's Underground Sewer Project (1855 CE) was implemented, and the flow of the river Chicago was reversed, taking the city's sewerage away from Lake Michigan into the Illinois-Michigan Canal (Salzmann, 2018).

Recurrent floods and the occasional subsidence were a common experience for the cities built following the draining of aqueous terrains. Since the demolition of the Mexica city and the construction of the Spanish one in the 16th century, up until the final desiccation of the Lake Texcoco in the 20th century, recurrent flooding events were critical challenges for the city government, its officials, and engineering, every time prompting more advanced solutions to mitigate the damages (Montero-Rosado *et al.*, 2022). In the 19th century, floods were also seen as a threat to public health, strengthening the case for the desiccation of the lake and even of the entire Mexico Valley (Montero-Rosado *et al*., 2022). The series of drainage works eventually led to a differential subsidence. In Mexico City's very first century of existence, the city sank by more than 25 feet (Smith, 1998); now the rate of its sinking is 50 cm per year (Chaussard *et al*., 2021). The sinking of the ground was one of the challenges that the construction of the Metropolitan Cathedral faced; it took almost three centuries to complete (c. 1573-1813). In 1972 CE, a project of laying a new foundation was undertaken to mitigate the differential sinking of the cathedral (Ballesteros, 1994). Sometimes, to tackle the problem of flooding, especially that caused by subsidence, people have been raising their houses above flood levels incrementally (Campanella,

2018), as was in the case of New Orleans, while the city of Chicago opted to raise the entire city and its buildings to free it of swampy conditions in the mid-19th century (Salzmann, 2018). The North Sea Flood of 1953, which caused the flooding of a substantial area, damage to buildings, and a loss of livestock and human life, including the breaching of sea defences in the Netherlands (Fig. 6) and the eastern coast of the UK, was the most catastrophic disaster in the history of the Netherlands (Hall, 2013). This flood is now part of the nation's collective memory, permanently preserved in the *Watersnoodmuseum* (Flood Museum) (Watersnoodmuseum, n.d.). This event prompted the Delta Works, a project which entailed a massive storm surge barrier built in order to protect the country's low-lying areas from the North Sea (Oosthoek, 2006).

Fig. 6 – Watersnoodramp *1953*, the Netherlands.
Source: Wikimedia Commons.

Before the Roman colonisation of Britain, many cultures inhabited its aqueous terrains, for them terrains were sacred, and shared a ritualistic connection with their watery environments (Rogers, 2013). The lived experiences of aqueous terrains shaped by the movement through these terrains by elevated timber trackways and/or causeways of pre-Roman times, occasionally coupled with their own cultural meanings (Historic England, 2018), must have been drastically modified during the Roman colonisation with the new waterfront-built forms such as harbours, ports, and other structures, and new cultural meanings superimposed by the Romans. Similarly, the modifications brought by the drain-and-fill and land reclamation practices, coupled with the introduction of new built forms of WMI such as dykes, channels, gates, locks, pumps, surge barriers, and a variety of waterfront structures, must have modified the human experience of water and landscape in general, influencing the cultural meanings of aqueous terrains.

It is important to note here that the phenomenology of water has received less attention than the phenomenology of land in understanding the experiences of settlements and their landscape settings (Rogers, 2013). Encountering and experiencing water is 'to understand water through the senses – seeing, touching, hearing, smelling and tasting water –, as well as the cultural attitudes towards water in relation to its colour, look and taste and the perceived effect of water on the human body' (Rogers, 2013). Unlike land, water is an element that always flows, and has its own spatiality and temporality (Mathur and Da Cunha, 2014). For the aqueous terrains, 'water inundation' is a phenomenological reality. There is a variety of land-water situations that change daily and/or seasonally, and over a long period, due to their ecological function of soil creation through the decomposition of plant material, flooding, erosion, and deposition (Keddy, 2000). This makes them amphibious, ephemeral, and thus unpredictable environments. While their liminal, unpredictable character was perceived as a threat to humans and cities, and articulated through their cultural pejoration, the drain-and-fill practice and the resulting WMI stripped these terrains of their breathing characteristics by separating land from water and their cultural meanings that were highly local. Eventually, they are reduced to 'controlled' water 'in' drainage channels, canals, 'trained' rivers, and 'behind' dykes, dams, gates, and locks. Thus, the artificial ground created by the WMI provides 'limited' experiences of 'controlled water' in 'tamed' landscape, largely visual. Lack of exposure to the wilderness of the flowing water and the liminality of aqueous terrains only render events of floods, tsunamis, and hurricanes a threat to human life and painstakingly built habitation, adding to the anxiety regarding such events (Berman, 2014). These anxieties prompt a harder and even stronger division between land and water, give rise to the narratives of 'deluge' and 'loss', and eventually wage a 'war against water'. Thus, the lived experiences of geography and of the city operate in close relation with cultural attitudes towards water, in general, and aqueous terrains, in particular, and are also shaped by their encounters as designed and planned in cities.

Interestingly, it could be observed that the lived experiences only strengthen the very same cultural attitudes and the idea/s of a city within which they are created, unless altogether a new cultural attitude and/or a new form of encounter is introduced.

3.4. Map-Making and Representation of Aqueous Terrains

Although the three aspects - cultural pejoration, imagining of a city, and lived experiences were in correspondence with each other and influenced one another, there were a few other aspects that joined them in support of the drain-and-fill practice and the resulting WMI. These were the traditional geographical concepts of land and water, and tools for surveying and mapping.

Due to the seasonal/daily fluctuation in water levels and the overlapping of these ecosystems with their adjacent terrestrial and deep-water ecosystems, aqueous terrains have always been fuzzy, in particular, their boundaries from a map-making point of view. The discipline of geography has historically defined *land* and *water* in opposition to each other. *Land* has been defined as "earth's surface that is not covered by water" (Oxford English Dictionary in Lahiri-Dutt, 2014), stressing the idea of solid ground, dry land (i.e., *terra firma*). *Land*, as "a unit of geography" and other equivalent terms such as "area" and "region", provided *land* a recognition as an entity with definitive limits (Lahiri-Dutt, 2014). Such a definitive understanding of *land* is manifested in terms of a *line* separating *land* from *water* on a map. On the other hand, rivers were reduced to lines and lakes to blob-shaped bodies of water, limiting the "time" factor of water, capturing only 'a hydrological moment' from the entire hydrological cycle (Mathur and Da Cunha, 2014). Thus, the watery landscapes were neither geographically conceptualised (Lahiri-Dutt, 2014) nor acknowledged on maps (Mathur and Da Cunha, 2009), and hence were open for manipulation. At the same time, rivers and lakes were provided with a snapshot understanding of water. Survey maps created based on such a limited representation of aqueous terrains formed the basis for thinking, designing, and planning of the WMI. Additionally, the rectilinear grids

found in land surveys were the outcome of the colonial land distribution process that goes back to ancient Greece (Wallace-Hadrill, 2022), which has survived through time, taking place at a much greater scale. This can be observed in the case of the USA, where it is thrust onto the entire country's natural terrain. This colonist view on land has always conflicted with the fluidity and ephemerality of aqueous terrains (Fig. 7).

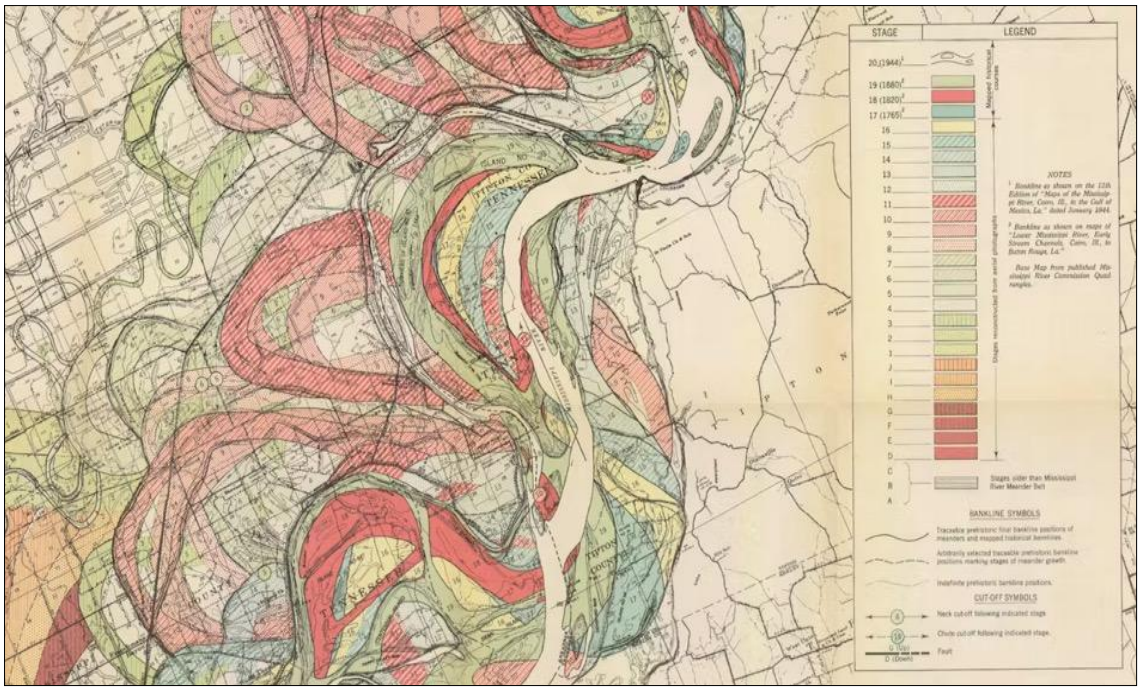

Fig. 7 – Ancient Courses: Harold Fisk's Meander Maps of the Mississippi River (c.1944).
Source: The Public Domain Review.

There is no need to mention the strength of maps as manipulation tools. The technical tool of map-making, when intercepted by the political and economic interests and cultural attitudes towards nature and its elements, becomes a cultural entity. At the time of Bombay's transfer from the Portuguese to the English Crown, it was an archipelago with tidal flats, salt marshes, and mangrove forests (Riding, 2018). The long-standing debate over the actual territory of Bombay between the Portuguese and the English Crown (and later the British East India Company) during the late 17th and early 18th centuries represents the difference in their geographic concept of Bombay's archipelago and its fuzzy landscape, driven by their political interest in the region (Riding, 2018). In an attempt to claim the larger territory and to make the colony self-sufficient, the British particularly mapped the inundated space in between islands as 'drowned land', 'overflown land/wasteland' and 'sea-water inlets' separating islands as 'breaches', making land reclamation plausible with a vision for a united Bombay Island (Riding, 2018). The narrative of the creation of Bombay by connecting seven islands and removing the sea between them came because of Murphy's Map of Bombay, containing seven islands (published in 1843), and its popularity. The map helped the British to glorify reclamation as a colonial project (Riding, 2018). In another instance, the 1524 Nuremberg plan of Tenochtitlan was prepared by the Spanish conquistadors, with the intention to make a case before the Spanish Imperial court for its conquest and subsequent demolition (Mundy, 1998). The map with the Templo Mayor at its centre, a main city square with twin pyramids, along with two skulls at its bottom indicating the human sacrificial ritual common to the Aztec, proved instrumental in rendering the Aztec people as 'barbaric' (Mundy, 1998), despite the city's

design being appreciated across Europe (Kim, 2006). For the 16th and 17th centuries' Venetian city builders, the floating city of Tenochtitlan was an ideal city, which motivated some of their own urban design projects for Venice's expansion during this period (Kim, 2006).

Thus, maps have often consolidated the concept of geography and its elements, the cultural meanings/attitudes towards them, and the political and economic interests, providing a physical and, more importantly, a spatial tool for the design and planning of the WMI.

4. CONCLUSION: IMAGINING THE WATER MANAGEMENT INFRASTRUCTURE

Reading the relationship between aqueous terrains and the water management infrastructure from the nature-culture perspective has brought out the intangible aspects influencing the imagining of the WMI. Since ancient Greek and Roman times until recently, the cultural pejoration of aqueous terrains and the people associated with them, the imagining of the city as the antithesis of nature, and the lived experiences mediated through the preference for a dry culture have promoted and legitimised the practices of drain-and-fill and land reclamation. Although these three aspects have been influencing one another, the traditional geographical concepts of land and water and the tools of surveying and map-making have consolidated the three aspects. Together, they valorised 'land', consolidated the conventional land-water binary, putting water in the service of land. These intangible aspects have provided the resulting WMI with its prime functions of 'separating land from water' and 'protecting the dry land', and have provided it with its engineering garb. Thus, it is necessary to recognise and be aware of these aspects that play out behind the conventional parameters of efficiency, productivity, and management, in thinking, designing, and planning the WMI.

By collating this reading with the current ecological concerns of aqueous terrains and environmental degradation in general, it is realised that the drain-and-fill practice and the resulting WMI have not only dismissed the very existence of aqueous terrains but have also denied them their life-sustaining processes, raising the concern of environmental ethics. This reading done from the nature-culture perspective helps understand German social psychologist Harald Welzer's (2011) argument that the current natural crisis is not a crisis 'in nature', which must be managed, but a crisis 'of our relations with nature'.

Most importantly, the WMI and its components shape our encounters with aqueous terrains, the lived experiences, and, consequently, the cultural meanings as a response to these encounters and experiences, which shape, in turn, our cultural attitudes and actions. The awareness of this mediating role of the WMI and its components could potentially help us in breaking away from the age-old loop of the cultural pejoration of aqueous terrains, as well as in imagining the WMI in an entirely fresh perspective, as opposed to the old trajectory of separating land and water. In turn, this could leverage a newer imagining of human habitation in aqueous terrains.

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