Rituals and Residues

Mapping Mining Landscapes and Spatial Practices Along the Klip River

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SUMMARY

Water and its appropriation are critical to shaping human settlement dynamics. Water not only shapes our lives but also our perception of the environments we inhabit. In the case of South Africa, where water scarcity prevails, rivers, channels, dry riverbeds, and wetlands carry intrinsic value, prompting humans to assert control over these water sources through methods of redirection, construction, and manipulation of water flows.

This discourse centres on the Klip River in South Africa. The river spans approximately 120 kilometres, forming the largest tributary of the Vaal River (Freeman et al., 1997). The Klip River has been profoundly impacted by human appropriation, particularly over course of the past century. While acknowledging nature's integral role in shaping historical narratives, the Klip River, functioning as a conduit for water and sediments, has played a pivotal role in shaping its surrounding landscape. Situated in the densely populated province of Gauteng, the Klip River serves as the primary drainage system for the Witwatersrand region, encompassing the southern part of Johannesburg, including the CBD and the township of Soweto (See Figure. 1).

Figure 1. illustrates the Klip River and its tributaries from origin to confluence with the Vaal River, 2014, W. Pheiffer

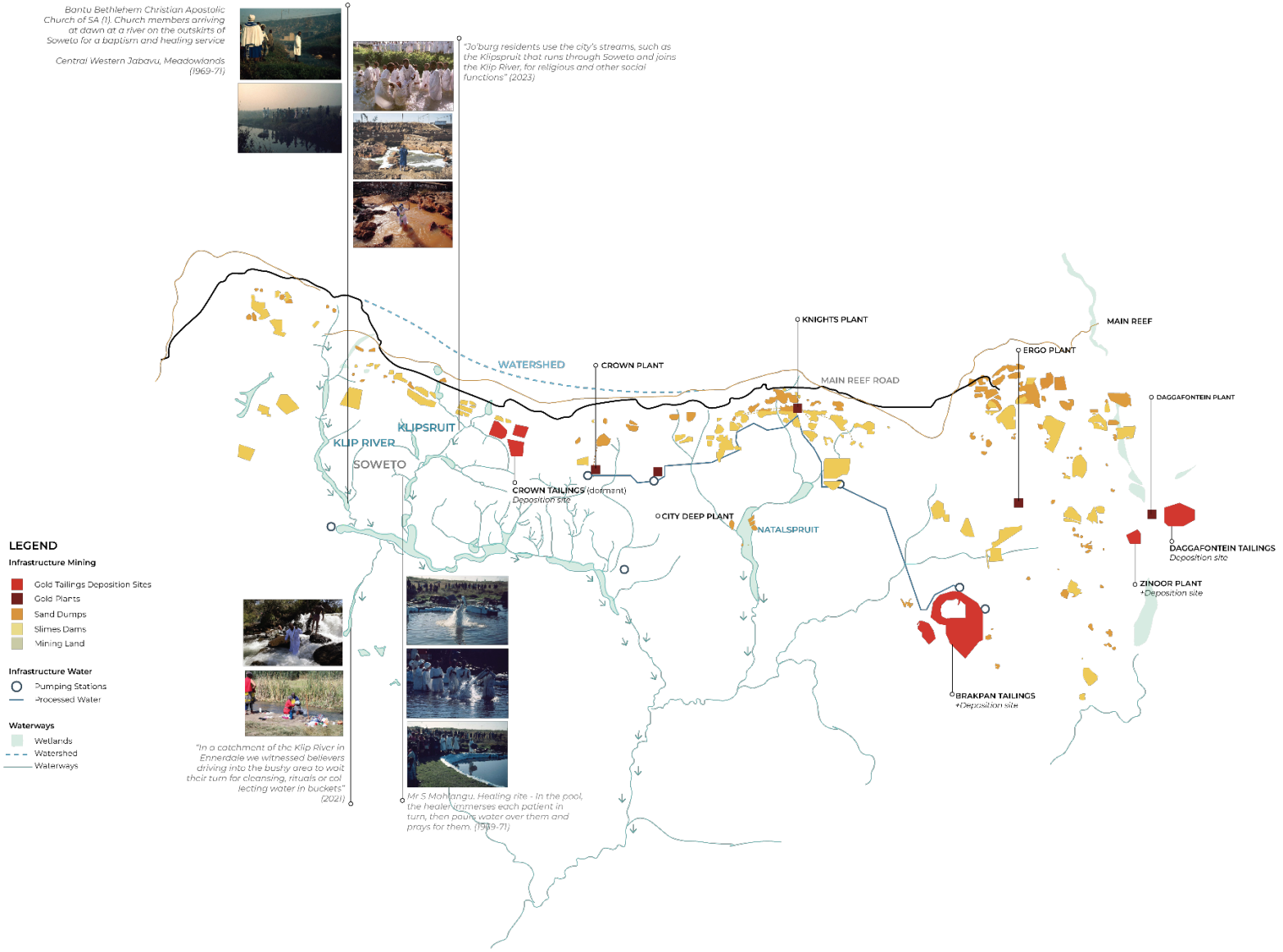
Ultimately merging with the Vaal River at Vereeniging, the Klip River assumes a crucial role in Gauteng's broader hydrological network, supplying water downstream of the Vaal Dam (Pheiffer et al., 2014).

Dating back to the late 19th century, gold mining along the Witwatersrand mining belt has left an indelible mark on the Gauteng region, with lasting consequences for its water ecosystems. The Klip River and its extended network of wetlands face challenges stemming from mining effluents and industrial pollution, which propagate downstream into the Vaal River and its extended Barrage system, contributing to an advanced degree of collapse (Bengu et al., 2017; McCarthy et al., 2007; Olasupo & Buah-Kwofie, 2021). Gold extraction, a driving force behind urban development in SA, has introduced challenges like acid mine drainage, heavy metal pollution, and compromised water quality in the Klip River, creating a spatial manifestation of toxicity that resonates through time (Chetty et al., 2021; Freeman et al., 1997; Marara & Palamuleni, 2019; McCarthy et al., 2007; Olasupo & Buah-Kwofie, 2021).

Embedded within this intricate narrative is the temporal nature of religious practices, notably river baptisms and immersion practices, which have parallelly endured over the course of a century (Kgatle & Modiba, 2023; Kiernan & West, 1977). The intersection of these practices with the urban environment unfolds as a rich socio-temporality, coinciding with the historical legacy of gold mining toxicity. Despite the looming threat of contamination from nearby mine sewage and waste, congregants in Klip River continue to partake in baptisms, immersing themselves in 'holy water' believed to possess spiritual significance (Bega, 2021; Masweneng, 2023). This century-old cultural practice not only reflects the resilience of religious traditions but also introduces a paradox – the coexistence of cleansing rituals with the potential hazards posed by the legacy of toxic gold mining (Kgatle & Modiba, 2023).

This paper extends a novel approach by exploring the intersection between mining-induced alterations to water systems and socio-cultural practices reliant upon them. This will ne achieved by tracing and locating the trajectory of toxicity along the Klip River -- from its origins in mine tailings to its impact on wetlands downstream, and cultural practices on its banks. Utilizing a diverse range of sources such as archival data, scientific journals, photo-essays, and contemporary newspaper articles, this study geolocates findings from existing analyses derived from environmental and social sciences, which are then overlaid with documented religious baptism practices that occur along the Klip River.

MAP: GEOLOCATING SPATIAL PRACTICES ALONG THE KLIP RIVER



(Own work, utilizing OpenStreetMap data alongside modified mining infrastructure from Tahira Toffah's work (2012), and waterways and wetlands infrastructure from Pheiffer (2014))

INTRODUCTION

Figure 2. Johannesburg residents utilize the city's streams, like the Klipspruit in Soweto, which merges with the Klip River, for religious and social gatherings, 2023, K. Masweneng

"*To visit the Klip River at a weekend is to visit a pulsing, teeming church. Before even seeing the river, passersby can hear drums and singing*" (Kardas-Nelson, 2010)

The Klip River, coursing through the Soweto township southwest of Johannesburg, South Africa, assumes a pivotal role within the Upper Vaal River catchment management area. Its path winds through the township, demarcating catchment boundaries shaped by both historical mining activities and the proliferation of densely populated informal and semi-informal settlements (Bengu et al., 2017). However, the Klip River in Soweto carries more than just geographical importance; it is profound intertwined with the local community. The river serves as a revered sanctuary for members of Soweto's Independent Churches, where spiritual practices blend with communion with the environment—a tradition with centuries-old roots.

Soweto hosts a proliferation of Independent Churches, well documented in scholarship by Martin West (1977). The religious landscape in Soweto is characterized by a confluence of Christian denominations and independent religious entities, emblematic of the diverse spiritual expressions among its predominantly black inhabitants. The presence of Anglican, Methodist, Presbyterian, and Catholic churches, underscores the breadth of doctrinal and liturgical diversity within the community. Complementing these established denominations are a plethora of Independent Churches, estimated to exceed 900 distinct congregations,

each characterized by unique beliefs, rituals, and organizational frameworks. Notably, within the realm of Independent Churches, a salient division exists between Ethiopian and Zionist congregations. Ethiopian churches often maintain close affiliations with Protestant missionary traditions, preserving their doctrinal tenets and structural conventions. Conversely, Zionist churches emphasize experiential spirituality, emphasizing manifestations of the Holy Spirit, divine healing practices. These religious institutions serve as conduits for the synthesis of indigenous African spiritual customs with Christian doctrines, evident in the incorporation of traditional rituals such as drumming, dancing, and ancestral veneration alongside Christian sacraments (Kiernan & West, 1977).

Moreover, Independent Churches in Soweto exhibit a synthesis of traditional African spiritual practices and Western religious influences in their rituals and organizational structures. They maintain a reverence for ancestral spirits, emphasizing their potency and incorporating them into their belief systems. These churches also place significant emphasis on purification and healing rites, often conducted through immersion in rivers or streams. These purification ceremonies serve dual purposes: healing specific ailments and offering protection against spiritual malevolence. Prophets within these independent churches play a crucial role in prescribing healing methods, including immersion, and guiding congregants through spiritual practices, highlighting the importance of spiritual leadership in navigating urban life. Additionally, prophets are distinguished from other healers present in Soweto, such as faith-healers and diviners "*sangomas*", by their centrality within the church hierarchy and their focus on supernatural healing methods (Kiernan & West, 1977).

Through practices like immersion rituals and reverence for ancestral spirits, these churches establish a profound connection between faith and the natural world. Rivers serve as natural boundaries for this spiritual space, fostering an environment conducive to healing, purification, and spiritual communion. Daily, worshippers gather along its banks, engaging in meditation, pouring libations, and offering prayers from dawn until dusk (Kardas-Nelson, 2010). Amidst the Klip River's flowing waters, healing ceremonies and baptisms attract individuals from diverse denominations, seeking solace and spiritual renewal through immersion (see Figure 3) (Bega, 2021).

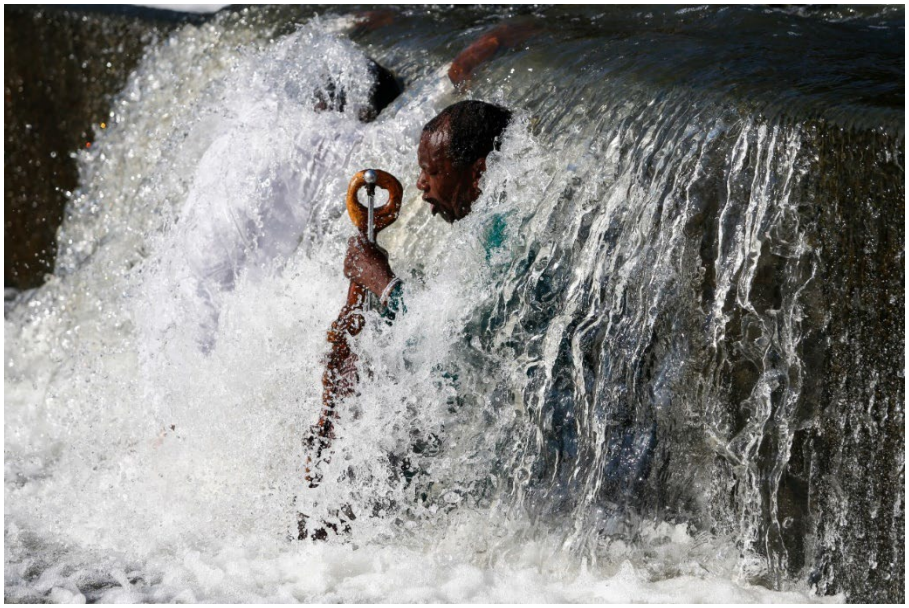


Figure 3. Down in the river to pray – Good Friday Baptism at the Klip River, 2024, F. Dlangamandla

Amidst its profound spiritual significance, the Klip River confronts a grim reality of toxic contamination stemming from diverse sources, including mine dumps, unlined tailings storage facilities, sewage, and garbage upstream (Chetty et al., 2021; Freeman et al., 1997). Compounded by the operations of mining entities such as DRD Gold's Crown Operation and the Central Rand Gold operation [1] (See Figure 4), as well as the decanting of acidified groundwater from Gauteng's Western Basin, the river faces significant threats (Bega, 2021). The pervasive presence of heavy metal pollution, acid mine drainage (AMD), and toxic substances like polycyclic aromatic hydrocarbons (PAHs) highlights the extent of contamination, thereby jeopardizing both human health and ecological equilibrium (Chetty et al., 2021; Freeman et al., 1997; Marara & Palamuleni, 2019; McCarthy et al., 2007; Olasupo & Buah-Kwofie, 2021).

[1] DRD Gold's Crown Operation and the Central Rand Gold operation, both subsidiaries of DRDGOLD, are situated in Brakpan and Carletonville respectively, forming the core operations of the company (DRDGold Limited, 2024). Ergo, located in Brakpan, and Far West Gold Recoveries (FWGR) near Carletonville, have a combined capacity of 1.8 million tons per month (mtpm), making it one of the largest gold surface tailings retreatment facilities globally (DRDGold Limited, 2024). Ergo processes material from primary surface sources, including sand and slime. Concerns were raised in 2010 by Soweto residents about potential threats to the Klip River from these operations (Tang & Watkins, 2011). A water test near the operations revealed a pH of 2, but both companies deny affecting the river. DRD Gold claims an investigation found no irregular spillage, while Central Rand Gold states they operate within a closed circuit and do not discharge outside their mining area. Water testing indicated the Klip River has a pH of 4.9, with elevated levels of iron and manganese, suggesting acid mine drainage (Tang & Watkins, 2011).

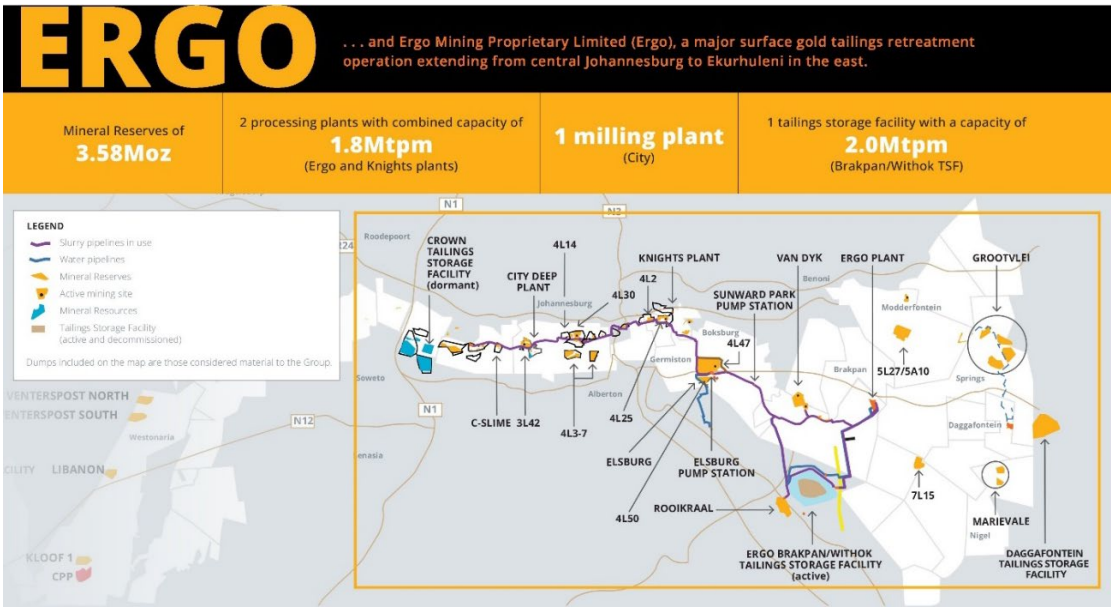


Figure 4. DRDGOLD comprises two subsidiaries: Ergo and Far West Gold Recoveries. Ergo is located some 50km east of Johannesburg in Brakpan, one of the largest gold tailings facilities globally, 2024, DRDGold Limited

Despite these formidable challenges, cultural rituals such as river baptisms persist, underscoring the resilience of religious and socio-cultural practices in the context of environmental deterioration. This study contributes to the nuanced comprehension of the complex interplay between environmental degradation, enduring socio-cultural traditions with roots spanning centuries, and pressing public health issues within the post-extraction landscapes of South Africa. It seeks to examine the impacts of a manufactured hydrological system with impacts across scales (See Figure 5).

Figure 5. Manufactured hydrological system with impacts across all scales.
[Left] DRD Gold's Crown Operation's gold surface tailings retreatment facility, 2024, Sibanye-Stillwater
[Center] Decant from West Rand Mine discharged into waterways, 2023, S. Reinders
[Right] Lydia Mokoena, a sangoma (traditional healer), performs a baptism in Soweto's Klip River, 2011, S. Reinders

Scholars like Maria Kaika have contributed to the exploration of urban environments through the lens of tracing hydrological systems and waterways, as seen in works like "Urban Water: A Political Ecology

Perspective". Kaika conceptualizes water as a 'quasi-object', akin to gas or petrol, undergoing production, purification, standardization, and commodification. Through processes of abstraction, damming, channelling, storage, distillation, and chlorination, water assumes a 'hybrid' status, straddling the realms of nature and human product (Kaika et al., 2002). As water traverses complex physical and socio-spatial networks, transitioning from production sites such as dams, wells, and purifying stations to consumption/reproduction locales like waterpoints and homes, its physical and social attributes evolve alongside its spatial relations (Kaika et al., 2002).

Additionally, a considerable body of literature has emerged on Johannesburg in the past two decades, encompassing interventions across critical geography and urban studies. In her book "Reading for Water: Materiality and Method" (2023) cultural historian Louise Bethlehem delves into the historical and contemporary dimensions of water management in Johannesburg, elucidating its intricate ties with colonial legacies and socio-political disparities. Through a critical analytical lens, Bethlehem underscores the necessity for comprehensive approaches to water governance that address environmental sustainability and social justice imperatives within the urban milieu.

Scholar Johann Tempelhoff's extensive scholarship offers a complementary perspective to Bethlehem's socio-political analysis. Tempelhoff’s work explores various aspects, including the indigenous relationship with the Vaal River in South Africa (Tempelhoff, 2006), the impact of agropastoral practices (Tempelhoff, 2008), and the influence of European trade and production models on water management strategies (Tempelhoff, 2005). Commencing with a historical overview from the Stone Age through the Iron Age and European colonization, Tempelhoff traces the evolution of water management practices in SA. He underscores how advancements in agriculture, mining, and manufacturing sectors necessitated sophisticated hydrological technologies by the twentieth century. Tempelhoff also discusses the socio-political implications of water management decisions, particularly in the context of transboundary water governance and infrastructure development (Tempelhoff, 2017). In his book "South Africa’s water governance hydraulic mission (1912–2008) in a WEF-Nexus context," Tempelhoff provides a historical perspective on water governance in South Africa from 1910 to 2008, focusing on the country's response to climate change and increasing aridity (Tempelhoff, 2020). It further discusses contemporary changes in water governance since the establishment of the Department of Water and Sanitation in SA in 2014.

Existing literature on South African post-extraction landscapes also delves into critical themes such as extractivism and the Anthropocene, exploring issues like pollution, toxicity, and postcolonialism. Gabrielle Hecht and Hannah Le Roux's joint work "Bad Earth" investigates the spatial dimension of toxicity in post-extraction landscapes, particularly in the context of mining waste in South Africa. “Bad Earth” critically examines the use of mine waste as construction material, revealing how it perpetuates environmental injustices and poses long-term risks to human health. Another perspective is offered in Hecht's book "Residual Governance" (2003) where she explores gold and uranium mining wastes in South Africa, emphasizing the concept of residual governance—the governance of waste and discard, governance that is purposefully inefficient, and governance that treats people and places as waste and wastelands.

The impacts of mining on water resources specific to the context of Johannesburg have drawn considerable scholarly inquiry, reflecting the complex interplay between economic, environmental, and social factors. T.N. Toffah (2013) in "Reinstating water, resurrecting the Witwatersrand" examines the environmental crisis faced by Johannesburg's Witwatersrand mining belt since the 1970s, proposing a reevaluation of the area's potential productivity by emphasizing water systems. This paper critiques current strategies for addressing the acid mine water crisis and land redevelopment while exploring landscape urbanism's potential in shaping urbanization in the Global South. Contributing to this discourse, Bremner (2014) examines water's historical and social dimensions within mining contexts in their chapter on "Dissident Water" in "Architecture and the Paradox of Dissidence." Here, water's historical and social dimensions within mining contexts are explored, with a focus on acid mine water's impact on Johannesburg's political landscape. The heightened attention to geology within aesthetic and architectural practices following the emergence of acid mine water as a significant environmental concern is highlighted. In "Gold scorched earth and water: the hydropolitics of Johannesburg" by Turton et al. (2013), the focus is on the engineering challenges arising from Johannesburg's geological connection with the Witwatersrand watershed, the largest in southern Africa. It emphasizes the hydraulic link between South Africa's river basins, spanning international borders via transfer schemes. This highlights water management's escalating impact on interstate relations, shaping the emergence of the Southern African Hydropolitical Complex (Turton et al., 2013).

This paper seeks to extend existing literature by focusing on the Klip River in Johannesburg, offering a cross-scalar perspective on the impact of extensive mining activities on water resources and water-dependent

socio-cultural practices in Johannesburg, South Africa, particularly focusing on the Klip River.

The unique contribution of this paper lies in its emphasis on the hydrological ramifications of historical mining activities, shifting the narrative away from solely examining the physical remnants of extraction towards understanding the intricate interplay between mining-induced alterations to water systems and the small-scale socio-cultural practices reliant upon them. By foregrounding these narratives, the paper seeks to challenge dominant discourses that often overlook the agency and knowledge systems of marginalized communities in shaping their own futures amidst environmental challenges.

Ultimately, by offering a nuanced exploration of the intersection between mining, water resources, and spatial practices, this paper aims to contribute to broader conversations on environmental justice, sustainable development in addressing complex socio-environmental issues. Through its alternative lens, this study seeks to provide a holistic approach to understanding and mitigating the spatial impacts of extractive industries on water systems and the communities that depend on them. This paper seeks to answer the following research question:

To what extent has historical gold mining along the Witwatersrand mining belt, particularly its impact on the hydrology of the Klip River in Soweto, Johannesburg, influenced spatial practices and socio-cultural processes adjacent to and dependent on the river?

The paper's structure follows the trajectory of toxicity carried by the Klip River system, beginning with its origins amidst mine tailings (Chapter 1), progressing downstream to its interaction with wetlands as natural toxin sinks (Chapter 2), and extending to the riverbanks where cultural practices such as healing, and baptism rituals take place (Chapter 3). By examining spatial practices influenced by the river's impact from mining activities, the paper challenges the colonial narrative that places mining at the centre.

METHODOLOGY

This study seeks investigate the intricate interplay between water systems, socio-spatial practices, and historical legacies of resource extraction, focusing on the Klip within the context of Johannesburg, South Africa. The methodology employed in this paper seeks to enrich scientific mapping with both socio-cultural readings and understandings of the River and its spatial practices.

By incorporating geographic markers sourced from archives, complemented by the insights gleaned from photo-essays and recent newspaper articles, this study attempts to construct a nuanced understanding of the subject matter. This methodological approach aims to bridge the gap between scientific inquiry and socio-cultural intricacies, contributing to a more holistic comprehension of the dynamics at play.

The first chapter involves archival exploration, particularly utilizing records from the Barlow Rand Mines Archive spanning the 1930s to 1950s. These archives provide valuable insights into the origins of toxicity, tracing the narrative from underground mine operations to surface manifestations such as mine dumps and unlined tailings. Additionally, contemporary satellite imagery, notably from platforms like Google Earth, enables the mapping of abandoned mining operations and persistent toxic residues, offering insights into the enduring nature of contamination.

In the second chapter, a scientific dimension will be incorporated, leveraging existing literature and empirical data on the Klip River's ecological health. This includes analyses of water quality parameters such as pH levels and concentrations of pollutants like heavy metals and polycyclic aromatic hydrocarbons (PAHs) along the length of the river. Scientific mapping and data on the state of aquatic systems, wetlands, and peatlands supplements this approach, providing a comprehensive understanding of ecological degradation and its spatial extent downstream.

The sociocultural layer is explored in the third chapter, drawing from sources such as photographic essays, journalistic reports, and social media documentation. Martin West's photo essay on the independent churches of Soweto serves as a primary reference point, offering insights into spiritual practices along the Klip River (Kiernan & West, 1977). Additionally, contemporary news articles and current day social media records provide ongoing narratives of cultural practices juxtaposed against the backdrop of environmental contamination.

By situating the research within these frameworks, it seeks to elucidate the historical and systemic dimensions of resource extraction, particularly in post-mining landscapes like the Klip River region. This critical approach prompts reflections on power dynamics, environmental injustices, and the politics of resource governance, thereby enriching understanding beyond surface-level resource depletion to encompass broader socioecological transformations over time.

CHAPTER 1: From Mines to Rivers

"The act of wresting minerals from the earth has historically required the subjugation and demeaning of both nature and humankind, as faceless pairs of hands and unseen laboring backs descend into the dark, inhuman hell of tunnels to strip away the organs of nature" (Mumford, 1934 in Bridge 2009: 45)

The historical practice of extracting minerals from the earth has frequently entailed the oppression and deterioration of both the natural environment and human beings. This is exemplified by deep-level gold mining operations in South Africa dating back to the 1900s. Deep underground, workers face perilous conditions as they drill into rock formations, exposing themselves to extreme heat and hazardous substances such as silica dust (Dube et al., 2021). Explosives are utilized to fracture ore, which is then brought to the surface for further processing. The extraction process involves crushing, milling, and dissolving of the ore in cyanide solution to extract gold (Durand, 2012). The resultant waste, including toxic sludge, is stored in large dams, leading to groundwater contamination, discharge of mining effluents into waterways, and emission of harmful substances into the atmosphere (McCarthy, 2010).

The influence of extraction processes on urbanization is profound. Technologies initially developed for mining, such as surveying, lifting, and construction, are integrated into urban infrastructure (see Figure 1.1). Furthermore, the rationalities behind geological science, emphasizing ecological simplification and radical abstraction continue to shape urban design principles.

Figure 1.1. [Left] The ERGO processing plant [2], depicted in this image, is anticipated to extract as much as 1.67 million ounces of gold — with a value estimated at 2.25 billion U.S. dollars — from mining dumps within the region, 2011, A. Watkins
[Right] The waste slurry generated from the gold processing plants is directed to three primary tailing deposition sites, also known as super dumps, located on the outskirts of the metropolitan area. These sites are managed by DRD Gold, a conglomerate formed by several remaining mining companies, 2011, A. Watkins

[2] Gold slurry undergoes washing and chemical processing at five gold processing plants spread across the Witwatersrand mining belt (Tang & Watkins, 2011).

Despite the significant impact of mining on both the environment and society, much of its intricacies remain invisible to the general public. Only the visible presence of mine dumps [3], slimes dams and mineshafts serve as reminders of the mining industry's footprint. In South Africa, this invisibility is reinforced by legal rights allocation (Redfield & Robins, 2016), and spatial representation through cartography. This invisibility perpetuates what scholar Rob Nixon (2013) terms "slow violence", wherein gradual environmental degradation, long-term health impacts on workers, and social injustices faced by nearby communities unfold imperceptibly over time. The obscured labor and processes of mining veil the true costs and impacts of the industry, enabling it to operate with minimal scrutiny and accountability. Thus, cycles of exploitation and harm persist unchecked.

Invisible Exploitation

The discovery of gold on the Witwatersrand belt in South Africa in 1886 led to the establishment of Johannesburg, giving rise to the world's largest gold reserves (Bremner, 2014). Subsequent exploration revealed additional gold-bearing sections of the reef both to the east and west, facilitating the emergence of towns such as Germiston and Boksburg to the east, and Krugersdorp, Roodepoort, Randfontein, and Klerksdorp to the west of Johannesburg (Adler et al., 2007) (see Figure 1.2). Over ensuing decades, further urban centers, including Nigel, Brakpan, and Carletonville, materialized along the Witwatersrand.

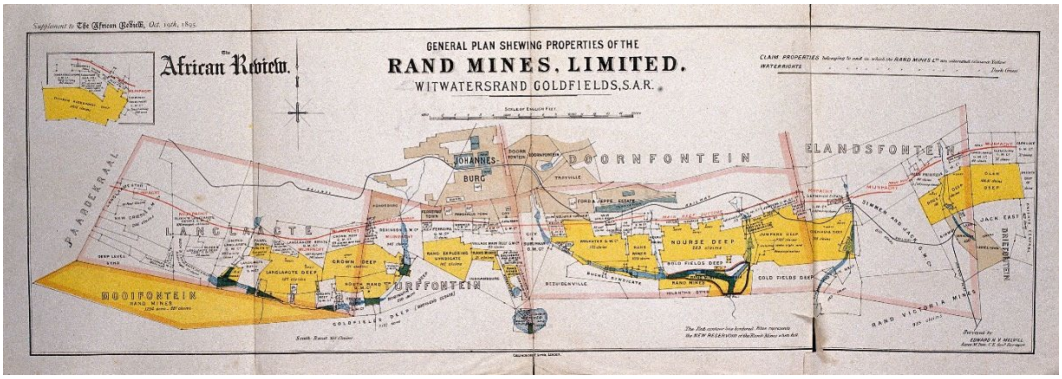


Figure 1.2. General plan showing properties of the Rand Mines, Limited. Witwatersrand Goldfields, 1895, S. A. R. Surveyed by Edward H. V. Melvill, Wellcome Collection

Under the apartheid regime, the establishment and development of settlements along the Witwatersrand mining belt were deeply

[3] Within the Witswatersrand region, there are three prominent super dumps: Brakpan, Crown Tailings, and Dragonfontein. Brakpan, the most expansive among them, spans 791 hectares and holds over 890 million metric tons of mining material (Bremner, 2014).

intertwined with the mining industry, which was a key pillar of the regime's economic policies (Phakathi, 2012). The apartheid government enforced racial segregation, with black South Africans relegated to inferior living conditions and limited employment opportunities. As a result, black townships and informal settlements emerged on the peripheries of major urban centers, particularly near mining operations (Maseko, 2021; Phakathi, 2012). Black townships such as Orlando, Kliptown -- which served as the nuclei for the development of Soweto (South Western Townships) -- along with Vosloorus, Katlehong, and Thembisa, were established in the peripheries of major urban centers (Adler et al., 2007). Over a short span, these settlements evolved from rudimentary mine camps to informal settlements, and eventually transformed into municipalities. Some of these municipalities eventually attained city status, notably Johannesburg within a few decades. Concurrently, informal settlements, or squatter camps, emerged in vacant spaces between towns, primarily as a result of rural migrants and individuals from neighboring countries seeking employment opportunities in the burgeoning urban centers, particularly within the mining and industrial sectors (Tang & Watkins, 2011) (See Figure 1.3).

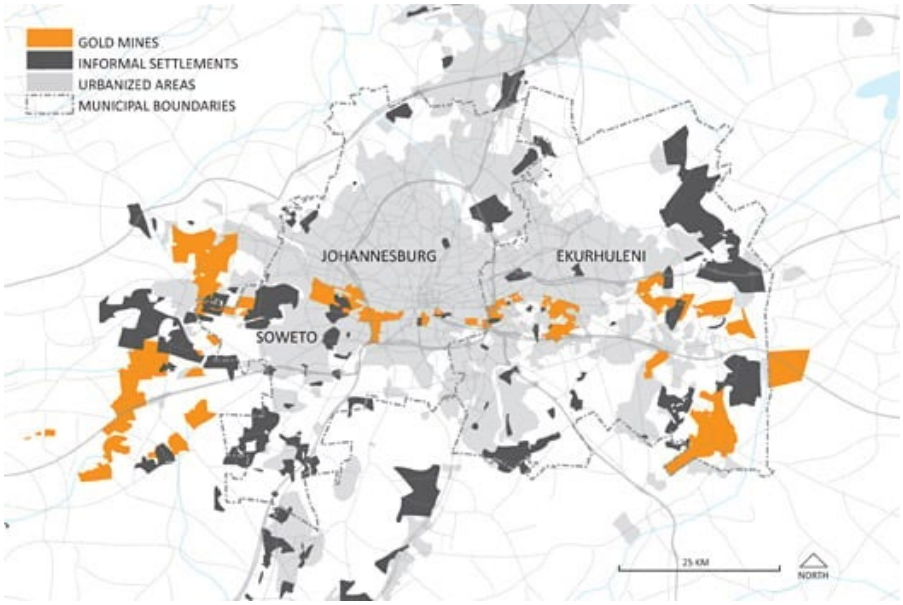


Figure 1.3. Map highlighting current state of gold mines, informal settlements[4], urbanized areas in relation to municipal boundaries, 2011, Tang & Watkins

Figure 1.4 illustrates a section of “Pictorial Map of the Witwatersrand Gold Field”, an abstraction of Johannesburg's mining enterprises

[4] Currently, around 1.6 million individuals, comprising 25 percent of the population in Johannesburg and Ekurhuleni, reside in informal settlements scattered across the metropolitan area. Within this population, approximately 400,000 people inhabit informal settlements located within the mining belt that spans the two municipalities (Tang & Watkins, 2011)

originating from the Gold Producers Committee in 1924. Positioned centrally within this depiction, Johannesburg is underscored with the inscription "Johannesburg, the World's Premier Gold Mining City" positioned above it. In the surrounding areas, more than 16 gold mines are marked, each accompanied by text detailing the number of employees – categorized as "*Europeans*" and "*Natives*", and the cumulative value of gold extracted from each mine till 1924.

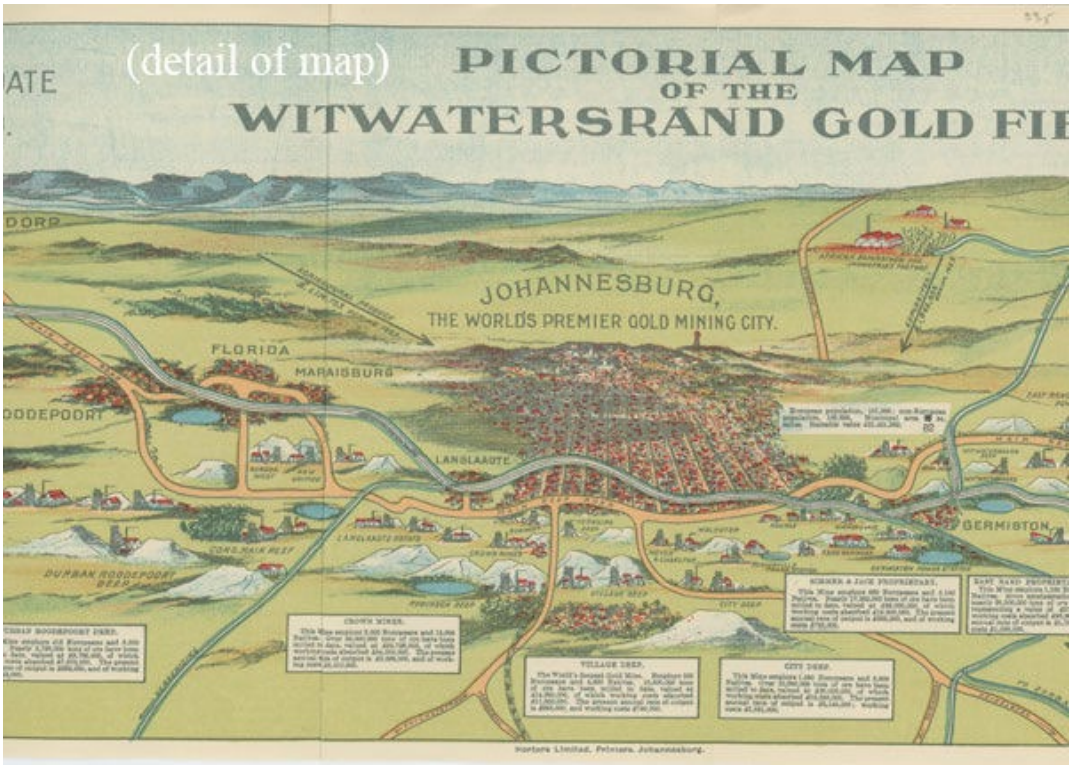


Figure 1.4. Pictorial Map of the Witwatersrand Gold Field. Gold Producers Committee. 1924. Folded color lithographic pictorial map, 8 x 24 inches.

The map's singular focus on gold extraction serves to glorify the economic success of the mining industry while disregarding its profound social and ecological repercussions. By abstracting representations of mine dumps and slime dams, the illustration minimizes the true scale of social and environmental devastation. Apartheid policies not only exacerbated social inequality but also contributed to environmental degradation and ecocide[5]. Black communities concentrated near mining areas faced exposure to pollution, including radioactive dust from the piles into informal settlements at the base (Knight, 2018). The depiction

[5] Ecocide is the extensive devastation of the environment due to human activities. Despite the absence of specific international legislation prohibiting ecocide, efforts are underway to rectify this. In 2021, a group of international legal experts proposed a definition for ecocide: "unlawful or reckless actions undertaken with knowledge that they are likely to cause severe, widespread, or long-term environmental harm" (Stop Ecocide International, 2021). This definition lays the groundwork for establishing an international law targeting the most egregious instances of environmental destruction.

of settlements and housing positioned at the base of these mine dumps abstracts the actual size of the piles, the extent of the dams, and the volume of the underground voids, thus downplaying the magnitude of the ecological disruption caused by mining operations.

Cartographic representations from archives often separated the above-ground world of city life from the below-ground world of mining – as can be seen in the "General Plan of the Goldfields" created by the Consulting Engineers Mining Drawing Office in 1964 (see Figure 1.5.), despite the tangible impact of geology on miners.

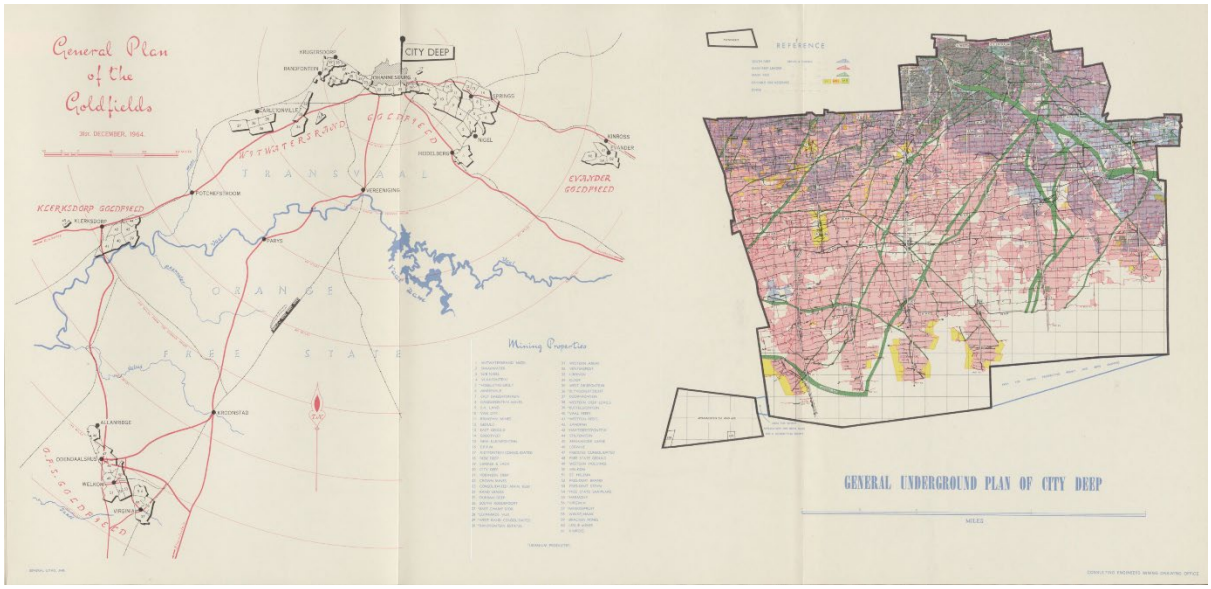


Figure 1.5. General Plan of the Goldfields. 1964. Research Archives, University of Witwatersrand, South Africa

While the map meticulously outlines the intricate network of mining infrastructure underground, the names of cities are conveniently reduced to the ones of economic relevance. Contamination plumes, underground aquifers rendered contaminated and unusable, rivers choked with mining effluents, and marginalized communities lacking access to clean water, are all eclipsed by the map's focus on industry and extraction. It was not until acid drainage seeping out of abandoned mines, alongside effluents mixing in surface and groundwater, that geology became a vibrant force in the political life of the city (McCarthy, 2010). This narrative perpetuates "slow violence," a subtle but enduring form of harm that operates over extended periods, often concealed by layers of abstraction and historical narratives (Nixon, 2013). It's crucial to acknowledge that colonial cartographic records not only serve as historical artifacts but also reinforce ideologies, shaping public perceptions of mining and perpetuating exploitative systems.

Paradoxical waters: Dewatering and Rewatering of the Rand

Communities and subregions along the Witwatersrand are marked by the influence of water evident in their Afrikaans place names, often characterized by endings like "*fontein*" (source) or "*spruit*" (spring), signifying the significance of small yet vital watercourses essential for local communities and ecosystems (see Figure 1.6).

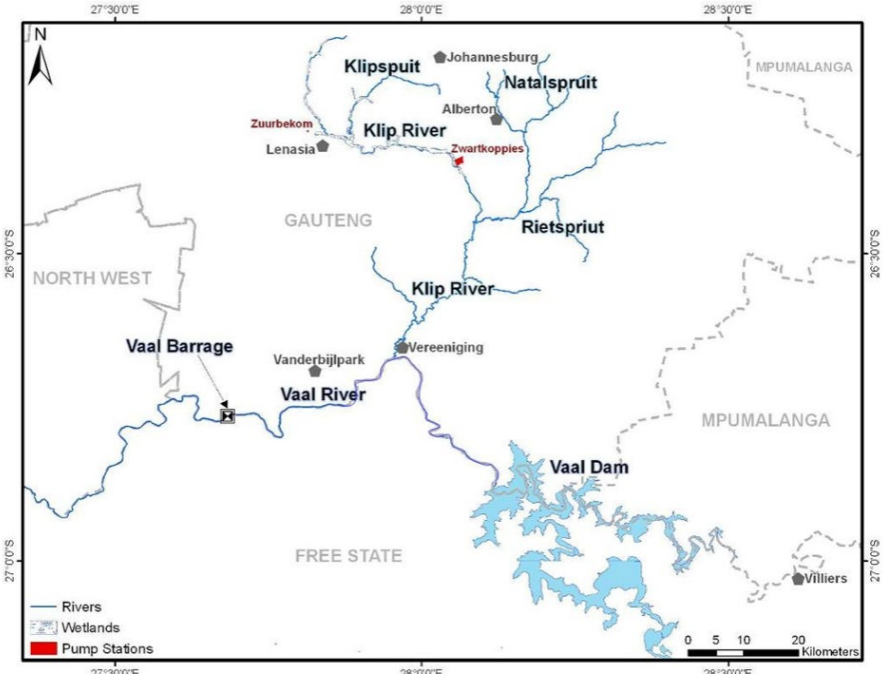


Figure 1.6. Gauteng region's extended river system

These names reflect the widespread network of dolomite-rich aquifers that lie beneath Gauteng and neighboring provinces (Durand, 2012). Groundwater emerges from these karst formations along the length of the Witwatersrand (see Figure 1.7).

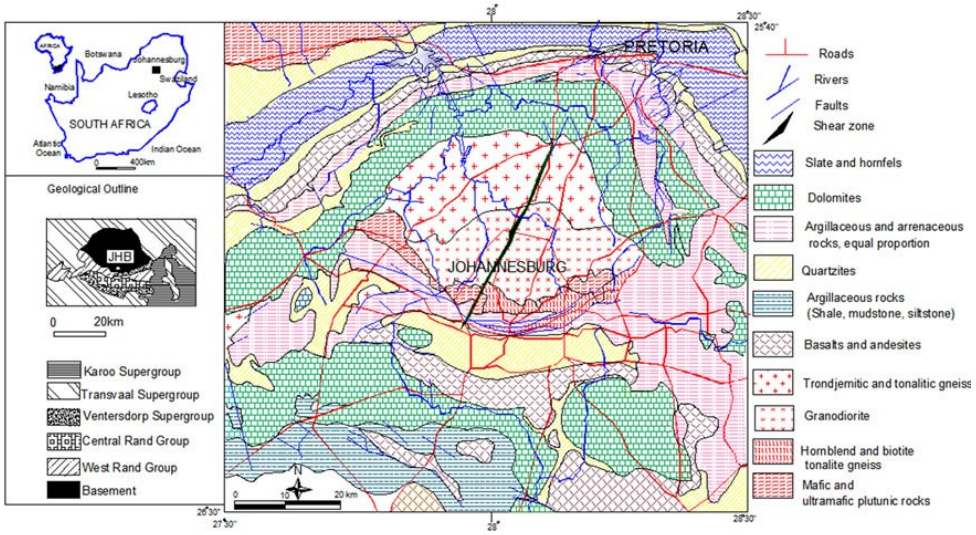


Figure 1.7. Geological Map of Johannesburg Area (Abiye et al., 2011)

The inherent value of Witwatersrand's gold deposits, situated at considerable depths and overlain by extensive dolomitic aquifers, made their extraction not only technically complex but also physically hazardous. Elaborate pumping systems (see Figure 1.8) were employed to draw groundwater from sunken shafts, a necessity for maximizing gold yields (McCarthy et al., 2007). Throughout the operational lifespan of gold mines across the East Rand, Central Rand, West Rand, and Far West Rand, the extraction of millions of liters of water from the mine void daily underscored the critical importance of water management in sustaining the mining industry's operations (McCarthy et al., 2007).

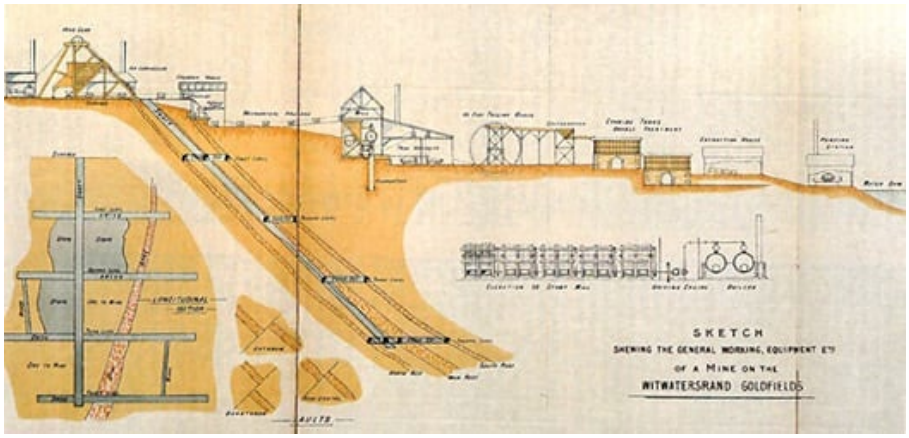


Figure 1.8. "Witwatersrand Gold—100 Years," edited by E.S.A. Antrobus, 1986, courtesy of the Geological Society of South Africa

The earliest reports of water ingress into the mines date back to the beginning of the previous century (O'Flaherty, 1903). Although initially independent entities, the gold mines on the Witwatersrand eventually interconnected as the tunnels and stopes of adjacent mines converged over time, either directly or through cracks and fissures in the rock. This process led to the formation of a continuous mine void extending from the East Rand to the West Rand.

Initially, individual mines were responsible for their own dewatering operations. However, as mines were exhausted and abandoned in the late 1990s, fewer mines remained responsible for dewatering the mine void (Bengu et al., 2017). Consequently, underground mine voids filled with water, leading to a phenomenon known as 'acid mine drainage' (AMD). This process facilitated the release of accumulated metals from unmined ore bodies, resulting in highly contaminated void water. Pyrite, abundant in the ore bodies (see Figure 1.9), played a central role in subsequent chemical reactions. When exposed to water and air, pyrite underwent oxidation processes, contributing to the acidification of water within the mine voids. This led to the dissolution of various metalloids and heavy metals, such as arsenic, mercury, and lead, into the surrounding water (Durand, 2012; McCarthy, 2010).

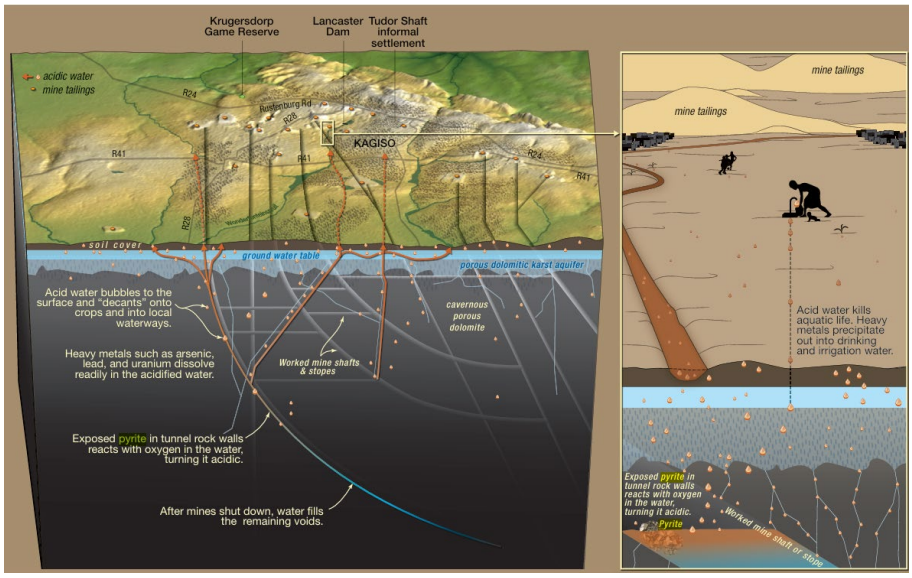


Figure 1.9. Scheme of acid mine drainage (AMD) in the West Rand, (n.d.) P. Robbins

Extensive water extraction by the mines contributed to a decline in water tables within and around the mining region, causing the springs that had given the name "Witwatersrand" to dry up (Dreybrodt, 1996; Enslin et al., 1996). This decrease in water tables also induced surface subsidence, particularly notable in the North West Province from the 1960s onward (Kleywegt and Pike, 1982). Surface subsidence appeared in the form of sinkholes and dolines, some exceeding 100 meters in diameter, scattered across a wide area (Swart et al., 2003). The rewatering of dolomites further facilitated karstification, as some sinkholes formed during the dewatering process were reactivated, and new ones emerged as the water table returned to its original pre-mining level (Beukes, 1987). Groundwater recharge rates were hastened by swallow holes and sinkholes formed during dewatering, diverting surface water runoff into these features (Swart et al., 2003). Moreover, the dewatering of the mines disrupted the natural flow of groundwater (Enslin et al., 1976; Dreybrodt, 1996).

While mine companies acknowledge that their slimes dams contribute to Acid Mine Drainage (AMD), they often assert that AMD effluent will diminish post-mine closure. However, the reality is that the more than 270 slimes dams in the Witwatersrand and Far West Rand, covering roughly 400 km2, will continue to pollute the surroundings until they erode away (Durand, 2012). Compounding this issue is the placement of many slimes dams on the continental divide and atop a vast karst aquifer, polluting two separate river systems and vital groundwater sources relied upon by millions (Freeman et al., 1997). The adverse and cumulative environmental impacts of mining may only peak over decades or even centuries.

Mining operations not only disrupted stream flow and groundwater recharge by releasing particle-rich effluent and water from gold mines, but also led to flooding, blockages in surface streams and aquifers, and the alteration of downstream wetlands. These sediments carried high concentrations of uranium and its radionuclides, which could re-dissolve in streams under acidic conditions, spreading traces of uranium far downstream. Additionally, the significant discharge of groundwater into surface streams like the Klip River, Wonderfonteinspruit, and others altered their characteristics, turning intermittent streams into permanent swamps containing mine effluent (Durand, 2012).

This highlights the far-reaching consequences of gold mining on the Witwatersrand region of South Africa. From the exploitation of human labor to the devastation of the natural environment, the true costs of this industry have been obscured for far too long. Chapter 2 will delve deeper into the downstream impacts of these mining operations, following the journey of toxic effluents as they travel along the Klip River, contaminating wetlands and exceeding the capacity of overburdened toxin sinks.

CHAPTER 2: The Journey Downstream

"The residual molecules of racial capitalism drive Anthropocene accelerations. They're building blocks of Anthropocene epistemology; measuring them is what has led scientists to declare the arrival of a new geological epoch." (Hecht, 2023 in Residual Governance: 12)

The Klip River holds a significant position within the hydrological network of the Gauteng region, playing a crucial role in water management and distribution (see Figure 2.1). Serving as the principal drainage artery for the southern expanse of Johannesburg, encompassing key urban zones like the CBD and the Soweto township, the Klip River's basin spans significant urban areas. Its course culminates in Vereeniging, where it merges with the Vaal River, a vital tributary of the Orange River.

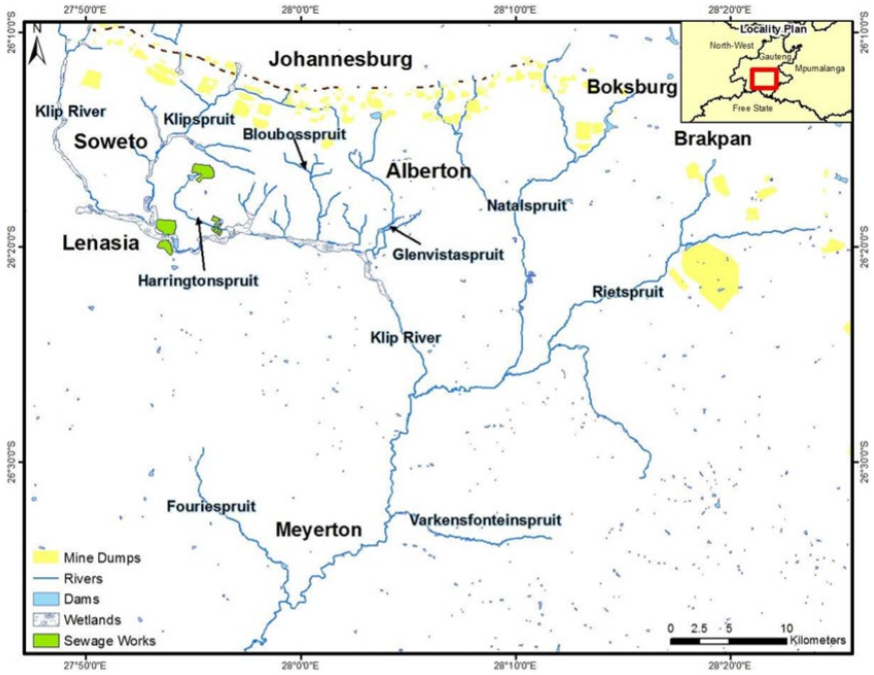


Figure 2.1. Location of the river system and water resources around the Klip River, 2003, V. Vermaak

This study attempts to locate the trajectory of toxicity through the lens of water, with the preceding chapter delving into the sources of toxicity—slime dams and mine tailings. These sources discharge mining effluents and acid mine drainage, which are subsequently carried downstream via the Klip River to the Vaal River (Chetty et al., 2021). This phenomenon has been extensively documented in scientific literature, detailing how the discharge of particle-laden effluent from gold mines disrupts stream flow and groundwater recharge, resulting in various environmental ramifications (Bengu et al., 2017; Chetty et al., 2021; Durand, 2012; Freeman et al., 1997). Surface streams are rendered susceptible to

flooding and obstruction, while underground aquifers crucial for groundwater replenishment face impediments. Moreover, the Klip River integrates into a vast network of wetlands, originally serving as natural toxin-sinks, now inundated by mining effluents (Bengu et al., 2017; McCarthy et al., 2007; Olasupo & Buah-Kwofie, 2021). The substantial discharge of groundwater into surface streams, transforms these water bodies into significant reservoirs or permanent swamps. Consequently, the Vaal River has garnered a lamentable reputation as a “sewage pit” in recent years (Tempelhoff, 2006).

Despite all its names and descriptions, the Vaal River remains a prominent natural feature shaping the landscape and influencing human interactions with the environment in a water-stressed region of South Africa. Understanding the broader perspective of the Vaal River and its connection to the Klip River is essential. By tracing indigenous ties and historical utilization, this study attempts to shift the focus away from solely mining impacts, elucidating the intricate interplay between human activities, water resources, and the environment.

The Hardest Working River in South Africa

The Vaal River, referred to as the “hardest working river in South Africa”, stretches over 1300 km from the Mpumalanga Highveld in the east to the arid Kalahari in the west (Tempelhoff, 2006). The river has served as a vital corridor for both human and animal movement across vast landscapes. Approximately two thousand years ago, the Vaal River facilitated communication between the water-rich environment near Lake Chrissie in the Drakensberg Plateau region, homeland of the ancient Batswa San, and the arid Kalahari. This waterway, along with its tributaries, provided a route for San communities transitioning to livestock farming, eventually becoming the Khoi people, to move from the Highveld into South Africa's interior. Unlike their hunter-gatherer ancestors, the Khoekhoen-speaking people had adapted to the Iron Age, introducing pastoral and Iron Age technology to new territories and assimilating cultural elements from migrating Bantu-speaking peoples from Central East Africa. By the late eighteenth century, the region around the Harts River and the confluence of the Vaal and Orange Rivers became a hub of cultural exchange, attracting various groups with mixed traditions (Tempelhoff, 2006).

Various groups, including those with mixed Iron Age and Stone Age traditions, as well as individuals of mixed colonial Asian and African or European descent, settled in areas around the Vaal River, relying on water sources for sustenance in the arid environment. Trekboers, missionaries, traders, and travelers utilized these passages into the

southern African interior, drawn by valuable environmental resources such as water, grass-covered banks for livestock, and timber for energy. However, crossing the Vaal River presented challenges, particularly during dry winter months, despite occasional ease of travel during rainy summer months. Historical accounts vary on suitable vessels for river travel, with the Khoi reported to have used tree stump vessels for crossing the Orange River, likely employing similar methods on the Vaal in arid regions (Tempelhoff, 2006).

In the 19th century, European settlement in South Africa's interior led to increased use of various vessels on the Vaal River for trade and travel. Notable expeditions by Thomas Baines and Karl Mauch demonstrated early navigation attempts, but challenges persisted due to the river's unpredictable nature, resulting in the establishment of ferries at crossings (Tempelhoff 2005). The strategic significance of water routes to diamond mining settlements (see Figure 2.2) led to the development of innovative transportation methods, including significant infrastructure advancements such as bridges in the 1890s.

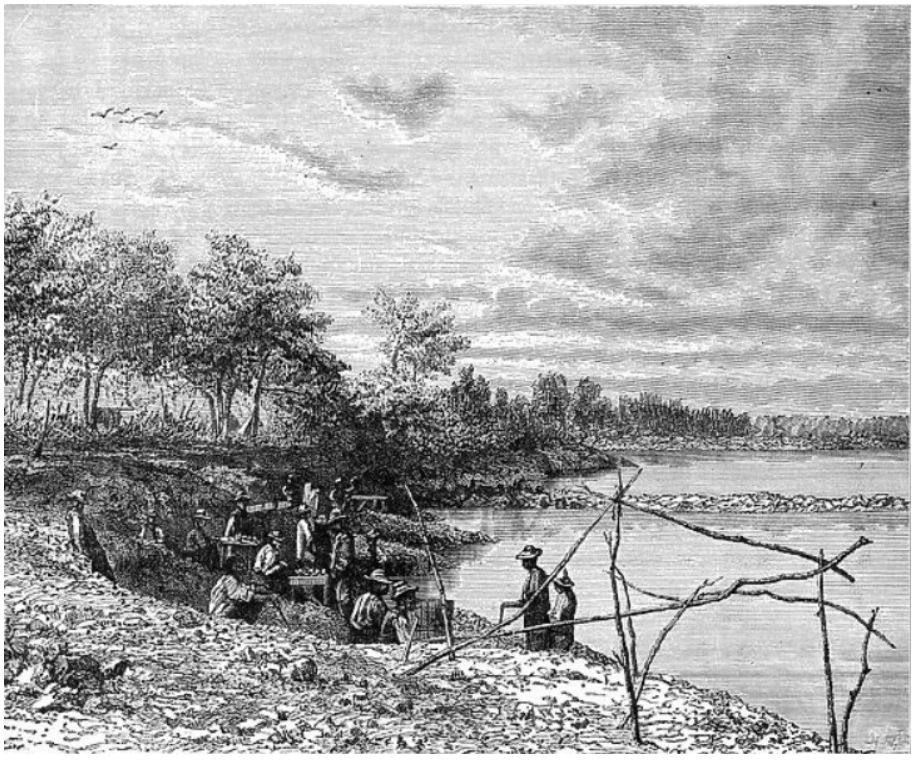


Figure 2.2 Washing sand for diamonds on the banks of the Vaal River, contemporary wood engraving, 1870, Granger Collection

The intellectual and political significance of the Vaal River in South African history has been substantial. From early missionary efforts in the 1820s by Reverend James Archbell to maintain contact with the Cape Colony's frontier and secure routes for missionary travel, to its role as a boundary marker between Afrikaner republics in the 19th century, the Vaal River has served various purposes (Tempelhoff, 2005). The river's

significance as a boundary became pronounced during the era of Afrikaner republics, particularly from the 1830s to 1902. Prior to European settlement, the region around the Vaal River was inhabited by various groups, including the Khumalo Ndebele under Mzilikazi. Conflict with Dutch Voortrekkers led Mzilikazi to move northward to Zimbabwe, ultimately resulting in the establishment of the Potchefstroom-Winburg Republic. The signing of the Sand River Convention in 1852 formalized the Vaal River as a boundary, ensuring British recognition of Transvaal independence. However, tensions between Boers and British persisted, shaping political discourse and territorial disputes. British interventions and agreements, such as the Treaty of London, continued to influence the river's political appropriation (Tempelhoff, 2005).

Rivers continued to play a crucial role in the early exploration of gold in the Transvaal Republic (Durand, 2012). Pieter Jacob Marais's discovery of alluvial gold along the Jukskei and Crocodile Rivers in 1853 marked the beginning of gold prospecting in the region. Early prospectors, initially fixated on river-based alluvial deposits, encountered limited success in uncovering the full extent of the Witwatersrand gold deposits. It wasn't until subsequent explorations, including David Wardrop's in 1878 and the Struben brothers' discovery of the Confidence Reef on the Wilgespruit River in September 1884, that the true potential of the region became apparent. The pivotal moment arrived in February 1886, when George Harrison unearthed the world's largest gold deposit on Langlaagte farm, catalysing extensive gold mining activity in the area (Durand, 2012).

Wetlands

In the early years of gold mining in the Witwatersrand during the 1900s, severe water shortages posed significant challenges. The growing towns and mining operations in the Witwatersrand gold field required a reliable water supply. The Klip River's vast network of wetlands[6] held importance in this regard, with substantial groundwater reservoirs found in the underlying dolomitic rocks (Abiye et al., 2011). Extraction of this groundwater commenced at Zuurbekom and Zwartkoppies pumping stations in in 1899 and 1905 respectively (see Figure 2.3).

[6] Wetlands are transitional areas between land and water, characterized by wet soils, specialized wetland plants, and a water table depth that maintains these features. There is no single definition for wetlands due to the varied ways land and water can merge. The Klip River Wetland, according to Grundling and Marneweck (1999), consists of four basins classified as valley-bottom fens, which are minerotrophic peatlands fed by groundwater rich in dissolved minerals, particularly calcium. Wetland systems play a crucial role in reducing or removing contaminants from water through mechanisms such as sedimentation, filtration, chemical precipitation, microbial interactions, and uptake by vegetation (Watson et al., 1989).

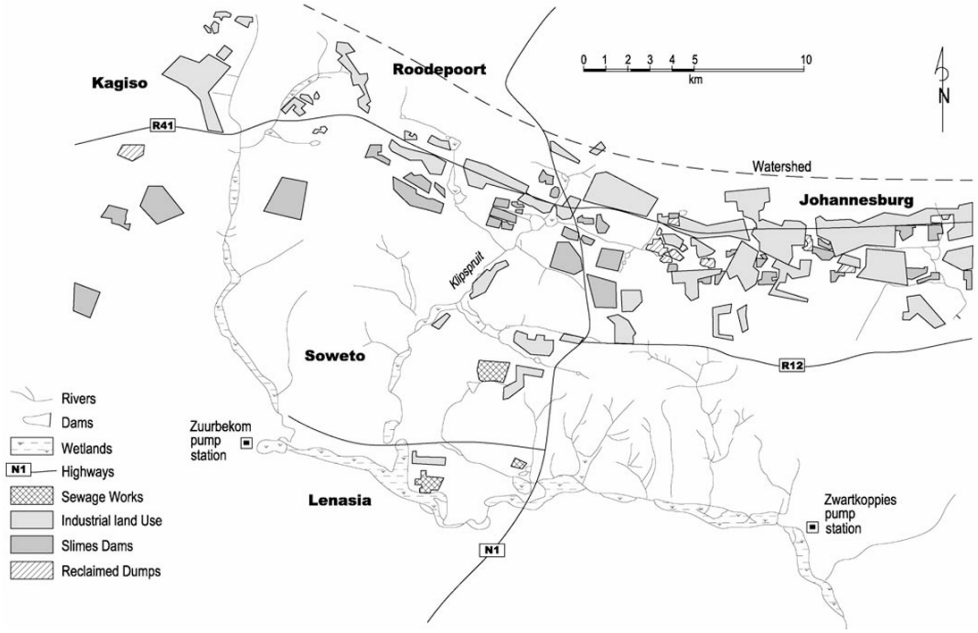


Figure 2.3 Location of the Klip River wetland in relation to industrial and mining development in the Johannesburg area, 2007, McCarthy

However, with increasing demands, the construction of the Vaal Barrage in 1923 became necessary to enhance water provision, leading to a diminished role for the dolomitic aquifers (McCarthy, 2007). While no longer fulfilling a primary water supply function, the wetlands have assumed paramount importance in other spheres, notably as a crucial agricultural domain and as a natural filtration site for contaminated water originating from the central and western Witwatersrand. This significance is underscored by the Klip River's proximity to the Vaal Barrage, facilitating the quasi-recycling of wastewater from the Witwatersrand, albeit in a diluted form (McCarthy, 2007). Furthermore, the stretch of the Vaal River upstream of the Barrage serves as a vital recreational area for the Gauteng region, underscoring the imperative of maintaining pristine water quality.

The Klip River, drawing from the southern expanse of metropolitan Johannesburg, shoulders the burden of industrial pollutants emanating from the Witwatersrand due to its unique geographic positioning. Notably, the northern watershed of the basin traverses the outcrops of the West Rand Group, constituting the Witwatersrand escarpment, thereby channelling much of the region's industrial effluents towards the Klip River through its northern tributaries. The Greater Johannesburg Transitional Metropolitan Council operates major wastewater treatment facilities within Johannesburg's southern drainage basin, with a portion of the effluent repurposed for irrigation while the remainder is discharged into the Klip River (Marara & Palamuleni, 2019).

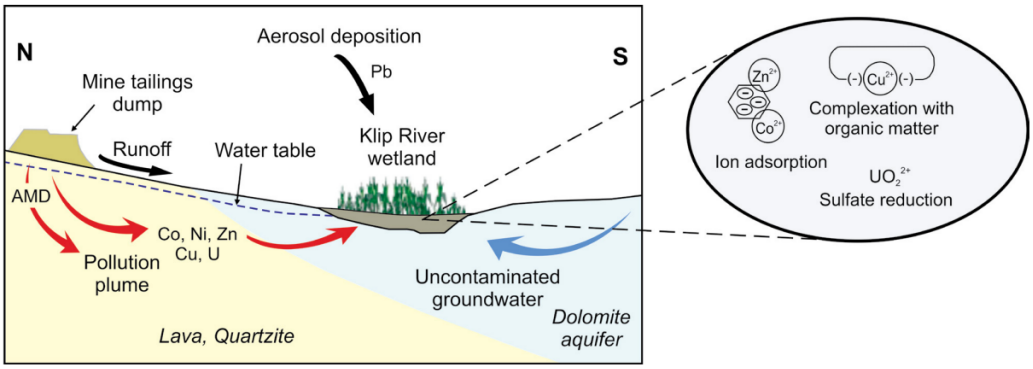


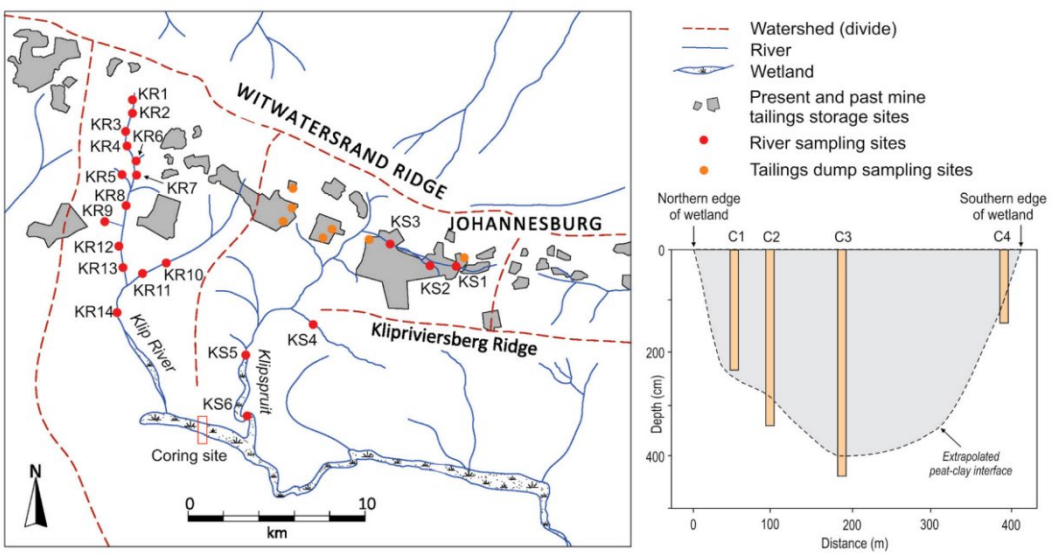
Figure 2.4 Transport of mining effluents from mine tailings dumps via run-off, acid mine drainage and pollution plume downstream to the Klip River wetlands which serve as toxin sinks, 2021, S. Chetty

Apart from purified wastewater, the Klip River receives inputs from underground mine water, urban runoff from Greater Soweto, portions of Roodepoort and Johannesburg, and flow from the Rietspruit, draining the Alberton, Germiston, and Boksburg areas. Cumulatively, these inputs detrimentally impact downstream utilization of the river water by domestic, agricultural, industrial, and recreational users, along with adverse effects on the natural environment (Chetty et al., 2021). Consequently, pollutant loads transported by the Klip River exert consequential effects on the water supply to the Vaal Barrage and extended Vaal River system.

The ramifications of the extensive groundwater extraction had sparked longstanding protests from farmers in the region due to its adverse effects on crop irrigation and contamination of local streams. Turton et al. (2006) recorded the initial pollution of the Klip River in 1894, leading to the death of livestock, with subsequent investigations revealing mine effluent as the culprit for polluting the water in the Doornfontein Valley (Durand, 2012). This marked the onset of a longstanding water resource management challenge. In response, the Rand Water Board (RWB) was established in 1903 to develop a secure water supply system. Adopting the Vaal River Development Scheme in 1914, the RWB commenced the first phase by constructing the Vaal Barrage, purification works, and pumping stations in Vereeniging, completed in 1923. Despite these efforts, by the 1980s, there was a noticeable increase in metal concentrations in the Vaal River at the Barrage, despite the Klip River wetland's recognized efficacy in attenuating pollution from industrial and mining sources (McCarthy, 2007).

The Klip River wetland's ability to remove phosphates and nitrates from treated sewage water has been extensively studied, with wetland biota effectively sequestering phosphorus, evident in the elevated phosphorus content of the wetland peat (Durand, 2012). However, the wetland faces numerous anthropogenic pressures over the past century, including acid water drainage from mines, peat extraction, sewage-

related pollution promoting eutrophication, and declining groundwater levels due to extraction (McCarthy, 2007). As a result, its capacity to mitigate phosphates, sulphates and nitrates has been compromised, posing potential eutrophication risks in the Vaal River upstream of the Barrage (see Figure 2.5). Additionally, degradation of the adjacent reed beds may release sequestered heavy metals, organic matter, and phosphates into the Vaal River system in the future.



	pH	Electrical conductivity (mS/m)	Al	Fe	Co	Ni	Zn	Cu	Pb	U
			mg/L							
Klip River (n = 14)										
Maximum	7.6	95	0.84	2.5	0.032	0.20	0.48	0.4	0.012	0.10
Minimum	4.3	15	<DL	<DL	0.0002	0.0012	<DL	<DL	<DL	<DL
Mean	6.7	52	0.091	0.30	0.0082	0.075	0.15	0.086	0.0028	0.020
s.d.	0.8	33	0.23	0.68	0.0088	0.064	0.12	0.10	0.0044	0.028
Klipspruit (n = 6)										
Maximum	7.8	379	60	330	2.1	2.7	2.8	0.35	0.0076	0.34
Minimum	6.5	15	<DL	0.012	0.0002	0.0044	0.073	<DL	<DL	<DL
Mean	7.1	112	8.9	47	0.33	0.46	0.66	0.10	0.0019	0.055
s.d.	0.6	150	22	124	0.77	1.0	0.99	0.14	0.0029	0.13
Wetland porewater (n = 94)										
Maximum	7.9	60	1000	804	8.9	47	30	14	1.4	8.1
Minimum	5.8	0.9	<DL	<DL	<DL	0.006	0.36	0.026	0.004	<DL
Mean	6.9	26	66	55	0.75	3.9	5.5	1.2	0.15	0.36
s.d.	0.4	5.6	155	118	1.4	7.3	6.6	1.9	0.27	1.1
DWAF[22]	6.5–8.4	<70	0.15	0.1	0.5	0.15	5	1	0.02	0.02
Central Basin void mine water[23] (n = 12)	3.0	397	120	40	4.7	10.6	9.1	0.33	0.028	0.61

Figure 2.5 The accompanying table depicts data for surface water catchment samples and porewater samples from the Klip River wetland, 2022, Chetty et al.

Insidious Pathways

As described in a report commission by the Water Research Commission (2004), assessed the radiological impact of mine water discharges, the consequences were dire. The expected outcomes of extensive groundwater extraction included the drying up of dolomitic aquifers and most irrigation boreholes, impacting farmers' water supply (Durand, 2012). To mitigate the losses incurred by farmers, water previously pumped by mines from underground sources was redirected to affected areas through a network of partially newly constructed channels and pipelines. However, concerns arose when farmers experienced crop failures and noticed fertility issues in their livestock, prompting suspicions that mining activities had compromised the quality of the dolomitic water.

The WRC's report further revealed the insidious pathways through which radioactive contamination infiltrated water, soil, livestock, and humans. Contrary to previous assumptions regarding the primary pollution pathway through drinking water, the report identified three other significant sources of contamination. According to the report, "crops and pastures irrigated by contaminated water, cattle imbibing contaminated sediments at riverbanks, and agricultural land contaminated by runoff from slimes dams" posed far greater dangers (see Figure 2.6).

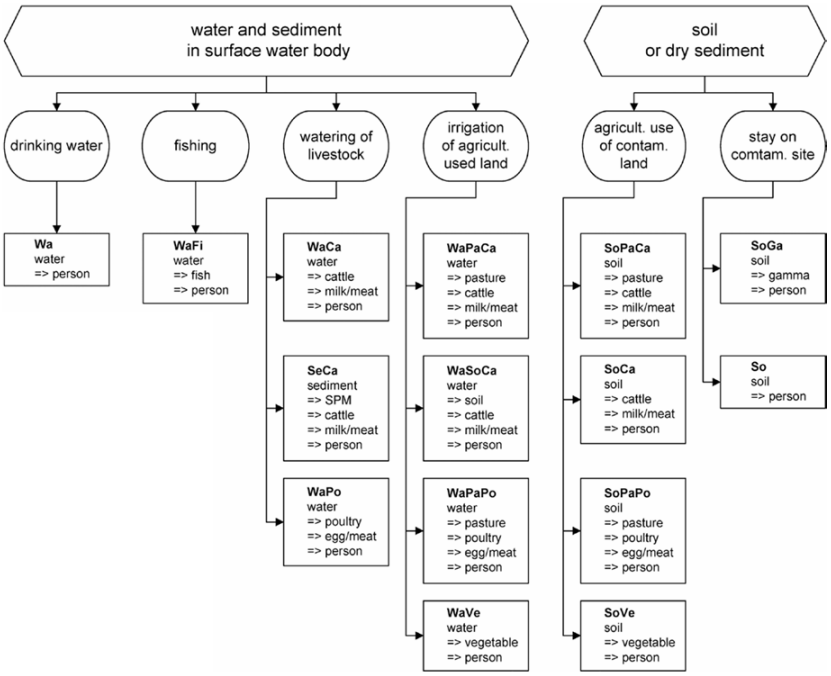


Figure 2.6 Pathways through which radioactive contamination entered water, soil, animals, and humans. Barthel, "Assessment of the Radiological Impact of the Mine Water Discharges"

The findings of the report challenged earlier assessments and underscored the severity of the situation, with radiation exposure at numerous sites exceeding safety limits. With hundreds of tailing storage facilities spanning vast areas and numerous unlined, non-vegetated dams, surface and groundwater pollution pose ongoing threats despite the wetlands offering some mitigation. Local residents lament the stark decline of once-thriving rivers, attributing the degradation primarily to mining activities (Adler et al., 2007). The critical role of wetlands in trapping toxic pollutants underscores the intricate relationship between industrial practices and environmental degradation. Within this context, environmental activists caution against the use of polluted water in religious ceremonies, emphasizing the risks to public health (Chetty et al., 2022). The subsequent chapter will delve into baptism practices at the Klip River, offering insights into the intersection of religious tradition, environmental context, and health concerns amidst continued extraction activities.

CHAPTER 3: Riverbank Rituals

This chapter delves into the intricate spatial and temporal dynamics surrounding the practice of baptism at the Klip River, offering a novel lens through which to understand the intersection of religious tradition, environmental context, and public health concerns. Departing from traditional narrative that often centralizes mining, the study focuses instead on the Klip River as a site hosting small-scale spatial practices, in particular the baptism practices and immersion rituals that take place in its streams. By geolocating photographic records of these baptism rituals along the river's spine, the interconnections between religious tradition, environment and public health are uncovered.

During the late nineteenth century, the religious landscape in South Africa underwent a significant transformation with the emergence of African independent churches[1]. This phenomenon was particularly pronounced in the expansive township of Soweto, Johannesburg. With approximately 3,000 independent churches spread across the Guateng region, of which 900 are situated in Soweto alone, these institutions garnered considerable interest from both anthropologists and missionaries (Lea 1926; Sundkler 1948) as one of the “new social forms of Africa” (Kiernan & West, 1977). Martin West’s "Bishops and Prophets in a Black City" stands as the pioneering work delving into the dynamics of these urban African independent churches (see Figure 3.1). These churches have been depicted in literature as both "schismatic" and "syncretist," yet they also embody an expression of spiritual devotion, often characterized by close-knit congregations. Furthermore, they serve as significant sites for the indigenization of religious rituals, with a particular emphasis on medical pluralism and healing practices (see Figure 3.2) (Bosire et al., 2021). With approximately one quarter of the total African population affiliated with an independent church, these institutions represent a crucial aspect of religious and social life in urban African communities.

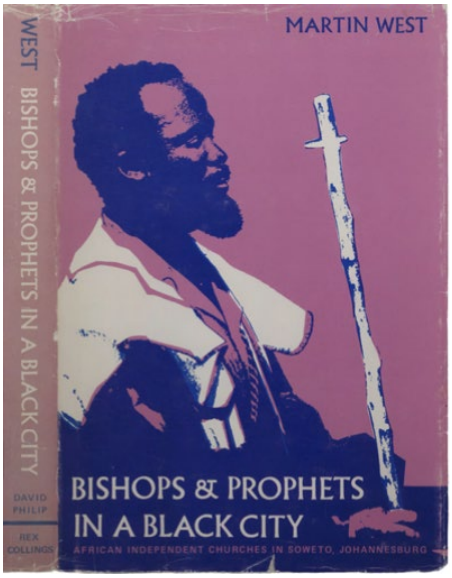


Figure 3.1 Bishops & Prophets in a Black City, Martin West (1977) – the first book on urban African Independent Churches

Social scientist Martin West extensively documented religious practices and daily life vignettes within Soweto, focusing particularly on the independent churches and their relationship to the urban environment. Hardships faced by individuals in South African townships, noting that while physical challenges may be less pronounced, issues like unjust family separation, restricted movement, insecurity due to land ownership limitations, and limited social mobility prevail. Soweto, being the largest township in Africa, exacerbates these problems. Consequently, independent churches have thrived in this environment, with approximately 900 separate churches. These churches operate as voluntary associations, differing significantly from mission churches that primarily recruit from within existing member families. Individuals join and switch churches based on their preferences, viewing membership as akin to any other organizational affiliation (Kiernan & West, 1977).

Due to the policies of Apartheid, many residents of townships hailed from rural areas. Regarding the composition of these congregations, most members are elderly with minimal education, predominantly originating from areas outside Johannesburg (Kiernan & West, 1977). Despite facing challenges adjusting to urban life, they have largely settled in Johannesburg permanently. The transition to city life entails grappling with significant differences, such as increased population density, heterogeneous demographics, and greater exposure to Western influences. To adapt to these changes, independent churches in Soweto blend traditional African and Western elements. In rural areas, religious practices were deeply connected to the landscape. Forced to relocate to urban areas temporarily, these religious rituals underwent adaptation to suit the urban environment. In the sprawling and impersonal

environment of Soweto, these churches serve as intimate communities where members find support and security amidst broader societal challenges (Kiernan & West, 1977).

Employing traditional anthropological methods such as administering questionnaires, participant observation, and informal interviews, Martin West immersed himself in the community. He attended various services in 18 different independent churches, including combined services, and regularly frequented 3 selected churches throughout most of his fieldwork. These churches offered a spectrum of rituals and events, ranging from consecrations and ordinations to baptisms, communion services, weddings, and funerals, in addition to routine services [1]. West's research, presented in his book, includes Figure 3.3, which illustrates the prevalence of six key features across a survey of 194 independent churches in Soweto. Notably, healing rituals and river baptisms emerge as widespread practices among these churches.

Features of 194 independent churches

Feature	Incidence	%
Healing	194	100
River baptism	180	93
Dancing	175	90
Prophets	170	88
Night communion	154	79
Drums	121	62

Figure 3.2 Features of 194 African Independent Churches in Soweto, 1977, M. West

Martin West's research sheds light on the multifaceted nature of river purification rites within Soweto's independent churches. These rites serve both healing and protective functions, with immersion often targeting specific ailments, particularly those believed to involve spiritual possession, as dictated by prophets. Moreover, within Soweto's Zionist-type churches, river immersions serve a protective purpose, enacted following significant events such as deaths or illnesses, or to forestall perceived misfortunes. Immersion in rivers, streams, or pools is regarded as a significant though less prevalent method of healing, resembling baptism rituals [7] (see Figure 3.3). Congregants assemble at the water body, usually in the early morning, initiating the process with

[7] Martin West (1977) describes the details of Baptism rituals at Independent Churches in Soweto. Baptism administered by the independent churches involves full immersion in a river, deemed necessary for recognition by the church. Candidates, after questioning by the Bishop, are immersed three times in the name of the Father, Son, and Holy Spirit by a designated leader. This act is distinct from healing or purification rites, although these may also involve immersion in the river, often prescribed by a prophet. Such purification may be aimed at healing specific ailments or providing general protection. Large-scale purifications, such as at the beginning of the year, are common, often coinciding with significant church events like Easter.

prayers and sometimes dancing (see Figures 3.4). Senior community members then immerse patients individually, after which they typically receive blessings from the attending bishop or another senior authority (see Figure 3.5).

Religious rituals, compelled to adapt to urban settings temporarily, have undergone transformations to better adapt to the urban environment. In Zionist-type churches, sacred spaces play a pivotal role, often adorned with symbols such as stars, crosses, moons, and suns (see Figures 3.10 and 3.11). Baptism ceremonies depicted in photographs showcase the reverence accorded to these symbols. In suburban areas of Johannesburg, one can observe small worn-out rings on grassy patches, which serve as examples (Kiernan & West, 1977). These circles, left unprotected during periods of inactivity, gain sanctity during services, sometimes augmented with candles and sticks. Riverbanks designated for baptisms or healing rituals are marked with white paint, as evidenced in Martin West's photo essays (see Figures 3.3, 3.4 and 3.5).

Figure 3.3, 3.4 and 3.5 Series of photos by Martin West taken between 1969-71, depicting independent faith healer Mr Mahlunga Healing rites at Dube, Soweto (Source: University of Cape Town libraries)

Figure 3.6 and 3.7 Photos by Martin West, depicting dawn baptism and healing at the river north-west of Soweto, photographs taken between 1969-71 (Source: University of Cape Town libraries)

Furthermore, general purification ceremonies, observed at the commencement of a new year or during pivotal church gatherings like Easter or conferences, underscore the ritualistic importance placed on river immersion. West's observations underscore the doctrinal significance attached to immersion baptism within Zionist-type churches in Soweto (see Figures 3.8).

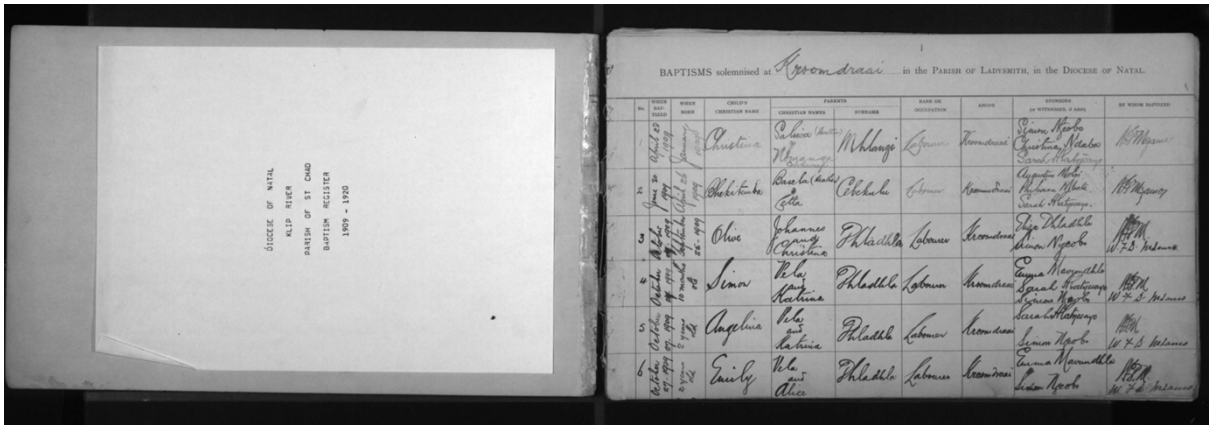


Figure 3.8 Baptism records at the Klip River (1909-1952) "NAT Klip River St. Chad Baptisms" – from Research Archives, University of Witwatersrand, South Africa

Martin West's captivating series of photographs, taken between 1969 and 1971, offers a glimpse into a previously overlooked segment of society and their spatial practices within the Africa Independent Churches of Soweto, a community obscured by the apartheid regime. Within this context, the Klip River in Soweto transcends its mere physical presence to become a sacred locus for congregants of independent churches. Acting as the natural boundary of their open-air sanctuary, it becomes the site where healing, purification, and spiritual communion converge (See Figures 3.8 and 3.9). As congregants gather along its banks, the river transforms into a vibrant center of worship and community connection.

Figure 3.8 and 3.9 Congregants making their way down to the river in Soweto for healing rites, photographs taken between 1969-71 (Source: University of Cape Town libraries)

Over the span of more than a century, the tradition of baptism and river immersion rituals has persisted along the banks of the Klip River in Gauteng, South Africa (Masweneng, 2023). However, amidst the longevity of these traditions, the region has undergone significant environmental changes, largely due to extensive resource extraction and rapid urbanization. Over the years, relentless mining activities have led to the depletion of aquifers and the contamination of water sources with toxic substances (Marara & Palamuleni, 2019). This environmental degradation has exacerbated the already challenging issue of water scarcity in the area, posing a threat to both human health and ecosystem stability. The insidious effects of what Rob Nixon termed "slow violence" (Nixon, 2013) are evident in the environmental degradation caused by abandoned mines along the Klip River. Acid drainage from these mines seeps into the surrounding water sources, carrying harmful pollutants such as arsenic, mercury, and lead (McCarthy et al., 2007). As water interacts with exposed rock faces, it becomes a conduit for heavy metals to leach into the river, further compromising its quality.

"This river was very important to us — people used to live from these rivers. Now, there's no aquatic life, there's nothing," (Bega, 2021) encapsulates the profound impact of these changes on the community's relationship with their natural environment. In the context of these environmental challenges, participants in baptism rituals unwittingly expose themselves to the hazards present in the polluted waters of the Klip River. Despite the spiritual significance of these rituals, their continuation in the face of environmental degradation further perpetuates the cycle of slow violence associated with unsustainable resource extraction practices.

Figure 3.10 and 3.11 [left] (Photo: Delwyn Verasamy/M&G); [right] Lydia Mokoena, a sangoma (traditional healer), performs a baptism in Soweto's Klip River, 2011. Acid mine drainage flows into the river, where thousands of baptisms take place each month (Photo by Samantha Reinders)

DISCUSSION

"The peoples of southern Africa have seen their landscape through a moral lens that imagines a land that is suffused with moral value, moral risks and dangers, and understands these as the consequence both of human habitation and of the agency of the plants, animals and minerals that compose the material of the land. This is manifested literally as a moral surface of images, action, places and persons. This moral landscape is a stable feature of the southern African longue durée" (Thornton in Gold Mines and Sacred Sites: The Moral Integration of the Southern African Landscape: 2)

The Klip River, with its rich tapestry of historical gold mining legacies, hydrological dynamics, and socio-cultural complexities spanning centuries, serves as a microcosm of a moral landscape deeply intertwined with human-environment interactions. The historical significance of the Vaal River as a water source for the Witwatersrand region, particularly during the 19th-century gold rush, highlights the intricate relationship between human activities and environmental resources.

Dating back to the late 19th century, gold mining along the Witwatersrand mining belt has left a profound impact on the Gauteng region, with enduring consequences for its water ecosystems. Challenges such as acid mine drainage, heavy metal pollution, and compromised water quality in the Klip River reflect the spatial manifestation of toxicity resulting from gold extraction, resonating through time.

Baptism rituals conducted along the banks of the Klip River offer a poignant glimpse into the intersection of spirituality, environmental degradation, and resource dynamics. Despite the looming threat of contamination from nearby gold mining activities, these rituals have persisted for over a century, underscoring the deep-rooted spiritual and cultural significance of water in the region. This century-old cultural practice introduces a paradox – the coexistence of cleansing rituals with the potential hazards posed by the legacy of toxic gold mining.

This study presents a novel approach by exploring the intricate connections between mining-induced alterations to water systems and socio-cultural practices dependent on them. By tracing the trajectory of toxicity along the Klip River – from its origins in mine tailings to its impact on downstream wetlands, and cultural practices on its banks – a multifaceted understanding of resource dynamics and socio-spatial relationships emerges.

Traditional frameworks often overlook the historical, systemic, and spatial dimensions of resource extraction, neglecting socio-cultural practices and temporal dynamics. Archival records, while meticulously outlining the mining infrastructure, often omit environmental degradation and social upheaval wrought by such operations, contributing to what can be termed as 'slow violence'. This insidious form of harm operates over extended periods, obscured by layers of abstraction and historical narratives.

The juxtaposition of baptism rituals and environmental degradation along the Klip River highlights broader issues of environmental justice. Acknowledging historical injustices embedded within the mining landscape prompts critical reflections on power dynamics and historical inequities in resource governance. This lens examines how colonial powers exploited water sources for economic gain, often at the expense of indigenous communities and their traditional practices, shaping access to and management of water resources today.

Viewing the Klip River through the lens of baptism rituals enriches our understanding of the complex interplay between culture, spirituality, and environmental sustainability. Recognizing the significance of socio-cultural practices in shaping resource dynamics can inform more inclusive and equitable approaches to resource management, prioritizing the well-being of both human communities and the natural environment.

Potential extensions include further exploration of tacit knowledge through fieldwork and ethnographic research, deepening our understanding of local perspectives and experiences within the context of environmental change.

CONCLUSION

In conclusion, the Klip River emerges as a microcosm of the intricate interplay between human activities, environmental dynamics, and cultural significance, showcasing a rich tapestry of historical legacies and contemporary challenges. Dating back to the 19th-century gold rush, the Gauteng region has been profoundly shaped by the legacy of gold mining along the Witwatersrand mining belt, leaving a lasting impact on its water ecosystems. This legacy is evidenced by ongoing challenges such as acid mine drainage, heavy metal pollution, and compromised water quality in the Klip River, reflecting the spatial manifestation of toxicity resulting from decades of gold extraction.

Amidst these environmental challenges, the tradition of baptism rituals conducted along the banks of the Klip River offers a poignant glimpse into the intersection of spirituality, environmental degradation, and resource dynamics. Despite the looming threat of contamination from nearby mining activities, these rituals have persisted for over a century, underscoring the deep-rooted spiritual and cultural significance of water in the region. This century-old cultural practice introduces a paradox – the coexistence of cleansing rituals with the potential hazards posed by the legacy of toxic mining.

By exploring the intricate connections between mining-induced alterations to water systems and socio-cultural practices dependent on them, this study presents a novel approach to understanding resource dynamics and socio-spatial relationships. Tracing the trajectory of toxicity along the Klip River – from its origins in mine tailings to its impact on downstream wetlands, and cultural practices on its banks – unveils a multifaceted understanding of the complex interplay between human activities and environmental resources.

Traditional frameworks often overlook the historical, systemic, and spatial dimensions of resource extraction, neglecting socio-cultural practices and temporal dynamics. Archival records, while meticulously outlining the mining infrastructure, often omit environmental degradation and social upheaval wrought by such operations, contributing to what can be termed as 'slow violence'. This insidious form of harm operates over extended periods, obscured by layers of abstraction and historical narratives.

The juxtaposition of baptism rituals and environmental degradation along the Klip River highlights broader issues of environmental justice. Acknowledging historical injustices embedded within the mining landscape prompts critical reflections on power dynamics and historical inequities in resource governance. This lens examines how colonial powers exploited water sources for economic gain, often at the

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Viewing the Klip River through the lens of baptism rituals enriches our understanding of the complex interplay between culture, spirituality, and environmental sustainability. Recognizing the significance of socio-cultural practices in shaping resource dynamics can inform more inclusive and equitable approaches to resource management, prioritizing the well-being of both human communities and the natural environment.

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