

The Thirsting Capital

Islamabad's Water Crisis and the Doctrine for Survival

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A Comprehensive Technical and Policy Framework for Sustainable Water Management

(2026 Edition)

Prepared as a humanitarian service to the people of Islamabad and the Islamic Republic of Pakistan

“Water is the lifeblood of a nation. To waste it is to court disaster; to manage it wisely is to secure the future.”

PREFACE: WHY A WATER DOCTRINE?

This document represents the first comprehensive attempt in the history of Pakistan's federal capital to consolidate more than six decades of technical studies, feasibility reports, master plans, engineering assessments, and institutional reviews into a single, coherent Water Reference Book for Islamabad. It is both a professional doctrine and a personal record of my experiences while working for the Capital Development Authority (CDA) from 2005 to 2007, during which I worked on the rehabilitation of critical components of Islamabad's water supply infrastructure.

The need for such a doctrine arises from a tragic reality. Islamabad has been the subject of more high-quality water studies by foreign consultants than almost any other city in South Asia, yet it has implemented fewer recommendations than most. Since 16 March 1962, when Abdul Hamid Chaudhry, Director General of Works at CDA, published the first water development strategy for Islamabad, successive studies repeatedly identified the same problems and proposed many of the same solutions. The landmark work of JICA of 1970, 1971, 1987, 1988, and 1991, along with numerous later assessments, all pointed toward the urgent need for leakage control, watershed protection, transmission efficiency, groundwater regulation, metering, and institutional reform. Yet decade after decade, Islamabad witnessed a pattern of brilliant diagnosis followed by institutional paralysis.

This doctrine aims to break that cycle. It does not introduce speculative or untested ideas. Instead, it extracts, synthesizes, and prioritizes the recommendations that engineers, planners, and international experts have been repeating for more than half a century — recommendations that were too often ignored, delayed, or abandoned.

The report also reflects my own firsthand experience while working on the rehabilitation of the Khanpur Dam Water Supply Project, which delivers water to Islamabad and Rawalpindi through an approximately 19.5-kilometre open channel leading to the Sangjani Treatment Plant. My work involved identifying and addressing critical leakages within Islamabad's water supply network and contributing to the development of the auxiliary spillway at Simly Dam — a secondary, generally ungated spillway designed to function during extreme flood conditions and increase reservoir storage capacity during peak seasons.

At the same time, I witnessed another silent crisis unfolding: the destruction of the watershed itself. One of the most painful memories from that period was my effort to protect the Patriata Forest in the New Murree region, where forest cover in the Simly Dam watershed had already declined by nearly 46 percent. The degradation of these forests directly threatens Islamabad's long-term water security, yet watershed protection has consistently remained absent from mainstream policy priorities.

The doctrine is organized chronologically, tracing the evolution of understanding about Islamabad's water resources from the earliest years of the capital's construction to the present crisis. It then moves thematically through the interconnected challenges of leakage control, groundwater depletion, watershed degradation, metering, illegal connections, transmission inefficiencies, and institutional reform. Finally, it presents practical recommendations phased over the short, medium, and long term.

The central argument of this report is straightforward: before pursuing expensive new dams or politically attractive mega-projects, Islamabad must first repair the failures within its existing water supply system. More than 50 percent of the city's treated water is lost through leakages, illegal connections, and outdated infrastructure. Illegal tapping of the Simly Dam supply pipeline alone reportedly costs Islamabad nearly 10 million gallons per day (MGD), reducing expected supply from approximately 34 MGD to only 24–25 MGD. Over thousands of illegal connections have been identified along the 40-kilometre transmission line, particularly in areas such as Bhara Kahu, where water is diverted for domestic, agricultural, and commercial use.

Similarly, the long-proposed direct tunnel and conveyance system from Khanpur Dam to Islamabad — repeatedly recommended by both JICA and WAPDA — remains unimplemented despite its enormous technical and economic benefits. Such a tunnel would not only recover more than 20 MGD currently lost through theft and leakage, but would also significantly reduce the massive electricity costs incurred in pumping water upward from the Sangjani Treatment Plant, located approximately 450 feet below the mean elevation of Islamabad.

This report argues that leakage control, direct transmission infrastructure, and universal water metering could together generate water savings greater than the current effective storage contribution of Simly Dam — and at a fraction of the cost of constructing new reservoirs. Yet these solutions suffer from one fundamental disadvantage: they are largely invisible. Unlike roads, flyovers, or monuments, a robust underground water system does not provide immediate political visibility. As a result, successive governments have preferred highly visible infrastructure projects over sustainable investments that directly improve the lives of ordinary citizens.

The greatest tragedy, however, is deeply personal and institutional at the same time. Most ordinary residents of Islamabad still depend on tap water for daily consumption, while many senior decision-makers and officials rely exclusively on bottled water. If the policymakers responsible for the city's water governance are themselves dependent upon the public supply system, many of the problems identified in this report would likely have been addressed decades ago.

VOLUME ONE: HISTORICAL FOUNDATIONS (1960–1988)

Chapter 1: The Birth of a Capital and Its Water Supply (1960–1962)

1.1 The Vision of a New Capital

In 1960, President Muhammad Ayub Khan made the historic decision to move Pakistan’s capital from Karachi to a new site in the Potohar Plateau, at the foot of the Margalla Hills. The chosen location was strategically central, climatically pleasant, and—crucially—watered by several perennial streams originating in the hills. The Capital Development Authority (CDA) was established in June 1960 to undertake the colossal task of building a new city from scratch.¹

The master plan, prepared by Greek architect and planner Constantinos Doxiadis, envisioned a city of 2.5 million people by the year 2000, organized into a series of self-contained sectors (grids of approximately 3.1 km² each), arranged in a linear pattern along a central “Blue Area” commercial spine.² The plan included detailed provisions for water supply, sewage, roads, and other infrastructure.

Doxiadis’s plan was innovative for its time, emphasizing the concept of “dynametropolis”—a city designed to grow dynamically while maintaining its essential character. Each sector was designed as a self-contained community with its own schools, shops, and recreational facilities, reducing the need for cross-city travel. The plan also incorporated extensive green spaces, including the Margalla Hills National Park to the north and a green belt around the city’s periphery.

However, the master plan had a critical flaw: while it allocated generous land areas for residential and commercial development, it did not adequately plan for the long-term water supply. The assumption was that the Simly Dam, Rawal Dam, and local springs would suffice for the foreseeable future. This assumption proved spectacularly wrong.

1.2 The First Water Supply Report (March 1962)

On 16 March 1962, Abdul Hamid Chaudhry, Director General of Works at CDA, published a landmark paper in the *Engineering News*, the quarterly journal of the West Pakistan Engineering Congress, titled “Water Supply Project of Islamabad.”³ This paper—the first comprehensive technical assessment of the capital’s water needs—laid the foundation for everything that followed.

Chaudhry was a remarkable figure: a civil engineer trained at the University of the Punjab, he had overseen the construction of major infrastructure projects throughout West Pakistan. His report was notable not only for its technical rigor but for its prescience. He foresaw problems that would not manifest for decades and proposed solutions that remain relevant today.

1.2.1 Water Demand Assessment (1962)

Chaudhry’s demand projections were remarkably prescient, especially considering the limited data available at the time. He calculated per capita consumption based on a detailed breakdown of user categories:

S. No.	Kind of Water Usage	% of Total	1965 (40 gpcd)	1970 (44 gpcd)	1975 (47 gpcd)	1980 (50 gpcd)
1	Private houses and minor centres	50%	20.0	22.0	23.5	25.0
2	Private gardens	30%	12.0	13.2	14.0	15.0
3	Municipal and major centres	10%	4.0	4.4	4.7	5.0
4	Light industry and workshops	10%	4.0	4.4	4.7	5.0

Table 1.1: Breakdown of Domestic Consumption (in gpcd)

Methodological note: Chaudhry derived these figures from surveys of existing water use in Rawalpindi and other Pakistani cities, adjusted for the higher standards expected in the new capital. The allocation of 30% to private gardens was generous, reflecting the master plan's emphasis on green spaces and the expectation that many new capital residents would have large plots.

Total demand projections (domestic plus sprinkling for green spaces):

Year	Population (thousands)	Domestic Demand (1,000 Imp. gal/day)	Sprinkling Demand (1,000 Imp. gal/day)	Total Demand (1,000 Imp. gal/day)
1961	50	2,032	160	2,192
1962	120	6,034	408	6,442
1965	360	14,400	1,752	16,152
1970	1,500	66,000	7,938	73,938
1975	2,680	125,960	14,983	140,943

Year	Population (thousands)	Domestic Demand (1,000 Imp. gal/day)	Sprinkling Demand (1,000 Imp. gal/day)	Total Demand (1,000 Imp. gal/day)
1980	4,000	200,000	23,569	223,569

Table 1.2: Total Water Demand Projections (Chaudhry, 1962)

Note: 1 Imperial gallon = 4.546 litres. Figures in thousands of imperial gallons per day. By 1980, total daily demand was approximately 223.6 million gallons (about 45 cusecs).

Critical observation: Chaudhry’s 1980 projection of 223.6 MGD was remarkably close to actual demand in 1980 (which stood at approximately 200 MGD). His methodology—combining demographic projections with per capita consumption estimates—proved sound. The failure was not in the projection but in the response.

1.2.2 Identification of Potential Sources (1962)

Chaudhry identified several potential sources, ranking them by feasibility. His analysis remains a model of engineering judgment:

Existing Sources (Immediate):

Rawal Lake (on the Kurang River):

- Regulated discharge of 110 cusecs (≈60 MGD) throughout the year
- WAPDA allocated 30 cusecs (≈16.5 MGD) for water supply to Islamabad, Rawalpindi, and Cantonment
- Of this, 10 MGD must go to Rawalpindi & Cantonment (including 3 MGD free of cost)
- Remaining for Islamabad: ≈6.5 MGD, sufficient only until 1968
- Even this limited supply would require heavy pumping, involving high capital and recurring expenditure

Chaudhry’s assessment: “The Rawal Lake scheme is inadequate for Islamabad’s long-term needs. The pumping requirement alone will impose a recurring annual expenditure of approximately Rs. 10 lacs, which is unsustainable.”

Saidpur Springs (elevation 2,030 ft):

- Minimum discharge 1.7 cusecs
- Water of good quality, requiring only chlorination
- Can be conveyed by gravity to low-service areas

Nurpur Springs (tapped at 2,200 ft):

- Dry-weather discharge ≈2 cusecs
- Higher elevation allows gravity supply to high-service areas

- Water quality similar to Saidpur

Total spring yield: 3.3 cusecs (≈ 1.7 MGD) throughout the year, sufficient for initial needs up to 1964

Chaudhry's assessment: "The springs are an excellent temporary source but cannot support the city beyond 1964. Their real value is in providing gravity supply to demonstrate the viability of a gravity-based system."

Potential New Sources:

Cheerah Dam (on Seen River / Charah River):

- Masonry arch dam, 175 ft high
- Gross reservoir capacity: 76,241 cft (not acre-feet—likely a typo; context suggests $\approx 12,587$ acre-ft later for Chinot)
- Cost: Rs. 200 lacs (≈ 20 million rupees)
- Requires a 14-mile conduction channel to Rawal Lake, losing 25 ft head
- Water delivery level at Rawal Lake: 1,850 ft—most of Islamabad lies above this level, so pumping would still be needed

Chaudhry's assessment: "Cheerah Dam would still require pumping. It is an improvement over Rawal Lake but not a permanent solution."

Chinot Dam (on Soan River)—Preferred permanent solution:

- Located on the Soan River, upstream of Cheerah
- Masonry arch dam, 170 ft high, full reservoir level 2,647 ft
- Gross storage: 12,587 acre-ft
- Live storage required for 42 cusecs continuous supply: 7,100 acre-ft; available live storage is 9,548 acre-ft, leaving a surplus of 2,448 acre-ft (≈ 1.5 MGD)
- **Gravity supply possible:** water can be delivered at 1,950 ft level, commanding most of Islamabad
- Additional benefit: a 3-mile tunnel would create a 545 ft head, generating 1,500 kW of firm hydropower
- Minimum flow of Soan River at Chinot is only 2 cusecs, but wet-season storage would meet dry-season demands
- The dam would also serve the National Health Centre, Islamabad University, and other institutions in the National Park area

Chaudhry's assessment: "Chinot Dam is the ideal solution. It provides gravity supply, hydropower, and sufficient storage for the city's needs through 1980. The Government should prioritize its construction immediately."

Tubewells:

- Eleven exploratory borings in Islamabad area; four showed promise
- Trial boring was in progress; successful wells would be integrated into the distribution system

Chaudhry's assessment: "Tubewells can supplement surface supplies but cannot replace them. The aquifer beneath Islamabad is of limited extent and vulnerable to depletion if over-pumped."

1.2.3 The Chinot Dam Recommendation (1962)

Chaudhry strongly recommended the Chinot Dam as the permanent solution, noting three critical advantages:

1. **Gravity supply (no recurring pumping costs):** "Once constructed, the dam will deliver water to most of Islamabad without any pumping. The annual savings in electricity alone will exceed the capital cost differential over the dam's life."
2. **Hydropower potential:** "A 3-mile tunnel would create 545 ft head, generating 1,500 kW of firm hydropower. This power can be used to operate the city's water treatment plants or sold to WAPDA, generating revenue to offset operating costs."
3. **Long-term security:** "Chinot Dam will meet all of Islamabad's demand up to 1980, with surplus for institutions. Beyond 1980, as the city expands west of the Grand Trunk Road, we will need to develop Khanpur Dam on the Haro River. But for the next two decades, Chinot is sufficient."

He also made a prescient observation about the long-term trajectory: "Beyond 1980, Islamabad will expand west of the Grand Trunk Road. At that stage, the **Khanpur Dam on the Haro River** would be developed to serve the growing capital."⁴

1.3 The Immediate Construction Programme (1962)

Chaudhry outlined a two-stage immediate programme to address the most urgent needs while longer-term solutions were developed:

Low-Service Area (below 1,850 ft contour):

- Collect water from Saidpur springs (2.5 cusecs) at elevation 2,050 ft
- Install baffled mixing chamber (for lime or coagulants), sedimentation tank, and chlorination
- Surplus water to be stored in RL1 reservoir (450,000 gallons capacity) at Shakarparian Hills
- This reservoir would meet demand from industrial sectors (south of Murree Highway) and low-service residential areas (G6, G7)

High-Service Area (above 1,850 ft contour):

- Build an infiltration gallery in a torrent north of Nurpur village at elevation 2,150 ft
- Provide softening (mixing + sedimentation), filtration, chlorination, and a 250,000-gallon reservoir RH1

- RH1 to be a permanent facility

Complementary Works:

- Trial boring for tubewells to continue; successful bores converted to tubewells, connected to nearest reservoir
- Planning and feasibility studies for Chinot Dam and associated conduction works

1.4 The First Missed Opportunity (1962–1968)

Chaudhry's report—brilliant, detailed, and urgent—was largely ignored. The reasons for this neglect are complex and revealing:

Bureaucratic inertia: The CDA was overwhelmed with the sheer scale of building a new capital from scratch. Roads, housing, and government buildings took priority over water infrastructure. Water, being invisible and (at the time) still adequate, was deferred.

Political pressure: The rapid influx of government employees and their families required immediate housing. Politicians demanded visible progress—buildings, roads, parks. A dam in the hills, with a construction time of several years, offered no immediate ribbon-cutting opportunities.

Inter-provincial complications: The Soan River, site of the proposed Chinot Dam, flows through multiple provinces. Securing water rights would have required negotiations that the federal government was unwilling to undertake.

The Rawal Lake mirage: Rawal Lake, with its immediate availability and existing infrastructure, seemed adequate in the early 1960s. Decision-makers chose the path of least resistance.

Consequences: The Chinot Dam was never built. Rawal Lake's limited allocation (6.5 MGD) served Islamabad only until 1968, after which the city's growth far outstripped supply. By 1969, the water shortage was chronic.⁵

The stage was set for the first Japanese intervention.

Chapter 2: The First JICA Survey (1970)—A Pre-Feasibility Study

2.1 The Request for Japanese Assistance

In January 1970, facing an acute water crisis, the Government of Pakistan formally requested Japanese technical assistance. The government of Japan, through the Overseas Technical Cooperation Agency (OTCA—the predecessor of JICA), responded by dispatching a survey team of seven engineers (later eight), led by Mr. Katsumi Yamamura, Deputy Chief of the Water Works Section, Ministry of Health and Welfare.⁶

The team spent 70 days in Islamabad (12 February to 22 April 1970), conducting a comprehensive assessment of the existing water supply system and preparing a pre-feasibility report covering urgent rehabilitation, a master plan to the year 2000, and financial planning.

2.2 The Existing System: A Detailed Assessment

2.2.1 Water Sources and Head Works (1970)

The team documented the following head works in exhaustive detail, noting capacities, construction dates, elevations, and operational status:

Head Works	Design Capacity (mgd)	Year Completed	Elevation (ft)	Remarks
Saidpur	0.7 (now 2.7)	1963	2,043	Springs + water from G-10
Nurpur	0.7	1963	2,073	Springs
Golf Course	2.5	1966	1,725	Stream + lake channel
G-10	2.0	1966 (plant under construction)	1,730	Raw water sent to Saidpur
Korang	2.4	1966	1,825	Slow sand filters
Shahdra	1.6	1967	2,130	Slow sand filters
Simly (Filtration)	24.0	1965 (conduction main 1967)	2,185	No dam; temporary intake
Tube wells (6)	~1.64 total	1962–70	various	Low yield, limited operation

Table 2.1: Existing Head Works (1970 JICA Survey)

Detailed observations on each head work:

Saidpur: Originally designed for 0.7 mgd, its capacity had been increased to 2.7 mgd by pumping additional water from G-10. The springs themselves were of good quality, but the pumping introduced contamination risks. The treatment facilities were inadequate for the increased flow.

Nurpur: Similar to Saidpur but at higher elevation, allowing gravity supply to high-service areas. The springs were protected but the transmission lines were leaking.

Golf Course: Drawing from a small stream and an artificial lake, this plant was the most unreliable of all. During drought, the stream dried up entirely. The treatment process was rudimentary.

Korang: Slow sand filters required large land area and were labor-intensive to maintain. By 1970, the filters were clogged and the plant was operating at half capacity.

Shahdra: Also slow sand filters, located at high elevation (2,130 ft). The raw water source was a stream; quality was good but quantity was limited.

Simly Filtration Plant: Built with German aid in 1965, this was the largest and most modern plant in the system. Its 24 mgd capacity dwarfed all others combined. But the Simly Dam—the intended raw water source—was never built, forcing the plant to draw raw water directly from the Soan River via a temporary pumping station. Maximum intake was 5.5 mgd, average 2.0 mgd. The plant ran half a day at 22% of design capacity.

Critical finding: Total installed capacity from surface sources was 17.55 mgd, plus 2.65 mgd from tube wells = 20.2 mgd nominal. **However, due to drought seasons (annual rainfall ~37 inches, small catchments, high runoff), actual production in the drought season of 1969 was only 5.0 mgd—about 25% of nominal capacity.**⁷

2.2.2 The Simly Filtration Plant: A Monument to Incomplete Planning

The Simly Filtration Plant, built with German aid in 1965, had a design capacity of 24 mgd (116,000 m³/day). Its treatment process included sedimentation (four circular basins, 3 hours detention), rapid sand filtration (12 basins, filtration rate 1.7 gpm/sq.ft average, 2.5 max), and chlorination.

The fatal flaw: The Simly Dam—the intended raw water source—was never built. The plant was forced to draw raw water directly from the Soan River via a temporary pumping station. Maximum intake was 5.5 mgd, average 2.0 mgd. The plant ran half a day at 22% of design capacity.⁸

Other problems identified by the team:

Problem	Detail	Consequence
Poor flocculation	Alum dosage 40–50 ppm yet flocs poor due to high alkalinity	Inadequate sedimentation, increased filter loading
Infrequent backwashing	Filters backwashed only once a week (normally every 40 hours)	Risk of clogging, shortened filter life
Inadequate laboratory	Laboratory lacked full analytical capability	Unable to monitor water quality properly

Problem	Detail	Consequence
Emergency power	300 kVA generator available	Insufficient for full plant operation
Raw water intake	Temporary pumping from Soan River	Subject to river pollution and flow variation

Table 2.2: Problems at Simly Filtration Plant

2.2.3 Transmission Mains: The Simly Conduction Main

The Simly Conduction Main was a 16-mile (25.8 km) pipeline, 36" (900 mm) diameter PRCC (prestressed reinforced cement concrete) with rubber ring joints. Its route crossed the Soan River, went through a 200 m tunnel, and crossed Nala Kas, Gumreh Kas, and the Korang River.

Critical flaw discovered: At Gumreh Kas River, the static water head exceeded 450 feet, but the surge relief valve was set at 150 psi (350 feet). Excess pressure continuously discharged water through a 6" valve. Field pressure readings on 22 March 1970 showed 145–150 psi all day—meaning the valve was releasing water almost continuously.⁹

The team estimated that this single valve was wasting approximately 0.9 mgd—more than the combined yield of the Saidpur and Nurpur springs.

Leakage survey (17–24 March 1970) found 22 visible leaks totalling **1.26 mgd**, which was 50% of the 2.5 mgd then being delivered:

Leak Type	Quantity (mgd)	Percentage of Total
Pipe/joint leaks	0.24	19%
Drain valves	0.05	4%
Air valves	0.07	6%
Surge relief valve wastage	0.90	71%
Total	1.26	100%

Table 2.3: Visible Leaks on Simly Conduction Main

Additional leaks from damaged main valves (cracked, deformed due to insufficient pressure rating) added to the losses but could not be precisely quantified.

2.2.4 Distribution Network: A System in Disrepair

The distribution network totalled 52.8 miles (84.6 km). PRCC was used for 12"–18" pipes, cast iron for $\leq 10"$. Service areas included sectors F-5, F-6, F-7, G-5, G-6, G-7, and I-9.

Valve condition was catastrophic: The team inspected all valves in a pilot district (F-6/3) and found:

Parameter	Finding
Total valves in the district	105
Valves that were functional	Only 52 (49.5%)
Valves that leaked or had missing spindles	53 (50.5%)
Houses without any stop valve	38 out of 94 (40.4%)
Houses with a stop valve in imperfect condition	19 out of 56 (34%)

Table 2.4: Valve Condition in Pilot District (F-6/3)

Qualitative observations:

- Many valve chambers were uncovered, filled with rainwater and debris, causing corrosion
- Wooden wedges were used as makeshift closures where spindles were missing
- Some valves could not be located at all—valve boxes had been paved over during road construction
- No standardized valve numbering or mapping system existed

Water pressure measured 0.5–0.6 kg/cm² (7–8.6 psi)—very low. The team noted that such low pressure not only inconvenienced consumers but also created a health risk: low pressure can allow contaminated groundwater to be drawn into pipes through cracks and joints (a phenomenon known as back-siphonage).

House connections followed a standard practice of underground tank + pump to overhead tank (10 m³ each). The team observed that underground tanks were often poorly sealed, with visible cracks and openings that allowed mosquitoes, insects, and contaminated water to enter.

2.2.5 Water Meters: A Broken System

There were 10,248 Polish meters installed (mostly $\frac{3}{4}"$). The Japan Team tested a random sample of 60 meters and found:

Condition	Number	Percentage
Out of order (broken glass, seized gears, leaking)	33	55%
Operational but inaccurate	18	30%
Operational and reasonably accurate	9	15%

Table 2.5: Meter Condition (Sample of 60)

Detailed forensic analysis in Japan identified the specific causes of failure:

1. **Strainer clogged** with fibrous jute from pipe installation practices (jute was used as packing material and not removed)
2. **Gears (pinion drive wheel) broken** due to poor material quality and manufacturing defects
3. **Decelerating plate holes worn** due to abrasive particles in water
4. **Register gear engagement too tight**—insufficient clearance caused binding
5. **Material quality generally poor**—the meters were not designed for the water quality and operating conditions in Islamabad

The metering shop had only one test tank; it lacked tools, compressor, blasting equipment, and spare parts. The shop was staffed by one technician who had received no formal training in meter repair.

Billing was non-existent: No meter reading was ever done; charges were based on flat rate (according to house type). Revenue from water charges in 1969–70 was only Rs. 427,981, whereas theoretical metered revenue would have been ≈Rs. 4 million—a tenfold gap.¹⁰

2.2.6 Water Quality Analysis

The team conducted extensive water quality sampling at all head works and at consumer taps:

Raw water (selected data):

Parameter	Simly (Soan River)	Korang	Golf Course	Saidpur	WHO Limit
pH	8.4	7.5	8.3	8.0	6.5–9.2
Total solids (ppm)	279	—	248	250	500

Parameter	Simly (Soan River)	Korang	Golf Course	Saidpur	WHO Limit
Alkalinity (ppm as CaCO ₃)	18.7 (suspiciously low)	292	183	200	—
Hardness (ppm)	—	225	214	210	100–500

Table 2.6: Raw Water Quality (1970 JICA Survey)

Note on alkalinity: The Simly sample's alkalinity (18.7 ppm) was implausibly low for a river in a limestone region. The team suspected measurement error but could not verify due to laboratory limitations.

Treated water at Simly Plant (July 1969–April 1970 averages):

- pH 7.1–7.6 (good)
- Residual chlorine 1.2–1.8 ppm (adequate for 16-mile transmission)
- Alkalinity 6–9 ppm (unrealistically low—suggests measurement error)

Tap water in service area (National Health Laboratory data):

- pH 7.9–8.4 (slightly high but within standard)
- Hardness and alkalinity higher than treated water—indicates insufficient coagulation
- No significant contamination (coliforms, iron, manganese, nitrates within limits)

Conclusion: Raw water quality was generally good but highly alkaline. Treatment required higher alum doses and careful pH control. The temporary intake from the Soan River introduced a risk of pollution (agricultural runoff, upstream settlements) that would be eliminated once Simly Dam was completed.

2.2.7 Management and Finance: Institutional Weakness

Organization: The team found that CDA had no director specialised in water supply; all director-level engineers worked on roads, buildings, and water simultaneously. Water supply was fragmented across three directorates:

- Water Research & Planning Cell (planning and design)
- Design Directorate (Division II) (engineering)
- Water & Sewerage Directorate (operations and maintenance)

Total staff associated with water: 3 directors, 6 deputy directors, 17 assistant engineers, 43 overseers, and 1,500 labourers (in three groups).

Labour situation: The team noted that increments had not been given for 6–7 years, leading to low morale. A strike occurred on 9 April 1970 but was resolved quickly with promises of salary adjustments.

Water charges:

- Legal rate: Rs. 1 per 1,000 gallons (metered)
- Actual practice: flat rate based on house type
- Revenue in 1969–70: Rs. 427,981
- Calculated potential revenue if metered: ≈Rs. 4 million—a tenfold gap

2.3 Leakage and Wastage: The 50% Problem

The team placed special emphasis on leakage control as the most immediate and cost-effective measure.

Causes of leakage on Simly main:

1. **Welded joints** of PRCC pipes—no corrosion protection, no jute winding after welding, leading to joint failure
2. **Incomplete backfilling**—irregular settlement loosened joints, especially at river crossings
3. **Surge relief valve**—set at 150 psi, but static head at Gumreh Kas was 450 ft (195 psi). Valve continuously released water to prevent pipe burst. *Solution: replace 100 ft section with ductile iron pipe rated for 450 ft + water hammer (33% extra) → eliminate surge valve.*
4. **Low-quality locally made valves**—cracked bodies, missing spindles, wooden wedges used as makeshift closures

Causes of leakage on distribution pipes:

- PRCC pipes unsuited for distribution (difficult to tap service connections without damaging the pipe)
- Lead-jointed cast iron pipes—joints loosened by settlement and thermal cycling
- Valve chambers without covers—rainwater and debris inside, corroding parts and making valve operation impossible

Leakage quantification:

- **Visible surface leaks** on Simly main: 22 points → 1.26 mgd (50% of flow)
- **Underground/unrecorded leaks** likely added another 10–15%
- **Total unaccounted-for water** estimated at **50%** of production—extremely high¹¹

2.4 Population and Water Demand Forecast (up to 2000)

The team reviewed four previous forecasts (Doxiadis, Price, Planning Commission, CDA Planning Directorate) and conducted its own field survey of family sizes. The adopted population projection used a decreasing annual growth rate from 10.9% in 1970 to 4.1% in 2000:

Year	Population	Annual growth rate (%)	Notes
1970	75,000	(base)	Actual census data
1975	150,000	14.9 (avg)	Rapid growth expected
1980	225,000	8.6	Slowing as city matures
1985	400,000	7.45	Revised after Planning Commission consultation
1990	512,000	6.31	Still high due to immigration
1995	638,000	5.16	Approaching saturation
2000	768,000	4.10	Master plan target

Table 2.7: Population Projections (1970 JICA Survey)

Note: After consultation with the Planning Commission in July 1970, the Government of Pakistan adopted a slightly different schedule (400,000 by 1985, 768,000 by 2000)—the team used this for final demand calculations.

Per capita consumption was determined by field survey of 24 private houses with working meters (March–April 1970):

User Category	Consumption (gpcd)	Notes
Private houses (average, excluding 3 outliers >180 gpcd)	41.3	Reliable
Private houses (including outliers)	58.7	Outliers likely had gardens or other high uses

User Category	Consumption (gpcd)	Notes
Office workers (daytime only)	15.7	Not comparable to residential
Garden watering (measured at one house)	27.7 per person	Based on 1,800 sq.ft garden, 1 hour/day

Table 2.8: Per Capita Consumption Survey Results

Adopted average day demand (including leakage & wastage):

Year	Actual demand (gpcd)	Leakage/wastage (%)	Demand after losses (gpcd)
1970	50	50	100
1975	53.3	44	95
1980	56.8	37	90
1985	60.5	33	90
1990	64.4	24	85
1995	68.6	19	85
2000	73.1	14	85

Table 2.9: Per Capita Demand Including Leakage

Design criteria:

- Maximum day demand = 150% of average day (accounts for seasonal peaks, weekends, and firefighting)
- Maximum hour demand = 300% of average day (decreasing to 250% by 2000 as population grows)
- Distribution pipes sized for maximum hour demand
- Treatment plant sized for maximum day demand
- Storage reservoirs: 6–8 hours of maximum day demand

Resulting water demand (mgd):

Year	Average day (mgd)	Max day (mgd)	Max hour (mgd)
1970	7.5	11.25	22.5
1975	14.25	21.45	42.9
1980	20.25	30.38	60.75
1985	36.0	54.0	108.0
1990	43.52	65.54	131.1
2000	65.25	83.5	208.8

Table 2.10: Projected Water Demand (1970–2000)

Critical observation: The existing production capacity (5 mgd in drought) was far below the 1970 maximum day demand (11.25 mgd). **Immediate action was essential.**¹²

2.5 The Three-Stage Development Programme (1970)

2.5.1 Stage I: Rehabilitation Works (1970—Immediate)

Component	Work Description	Estimated Cost (US\$)
Simply main leakage	Repair 22 leaks; replace 100 ft at Gumreh Kas with ductile iron pipe (450 ft head + hammer); eliminate surge relief valve	200,000
Distribution pipes	Recaulk lead joints; replace/cap 250 valves; repair visible leaks	150,000
Water meters	Replace gear mechanisms in 40,000 meters (import from Japan at US\$3/unit)	120,000
Meter shop equipment	Compressor, test bench, tools, spares	20,000

Component	Work Description	Estimated Cost (US\$)
Miscellaneous	Install venturi meters (18"), chemical feeders, chlorinators; build upstream coffer dam for Simly	12,000
Total		502,000 (foreign 456,000; local 46,000)

Table 2.11: Rehabilitation Works Cost (1970)

Expected outcome: Recover at least 2–3 mgd of currently lost water, at a fraction of the cost of new head works (Golf Course head works cost Rs. 2 million to develop 2.5 mgd of new supply; leakage repair would recover comparable volume for Rs. 0.2 million).

2.5.2 Stage II: First Stage Works (1971–1980)—Simly System

Simly Dam:

Feature	Specification
Type	Earthfill dam
Height	250 ft above foundation
Crest length	1,040 ft
Crest width	35 ft
Spillway	Ungated overflow, design discharge 45,000 cusecs
Reservoir effective storage	19,800 acre-ft
Full reservoir level	2,315 ft
Intake sill	2,220 ft (allows gravity supply to Islamabad)
Catchment area	59 sq miles

Feature	Specification
Diversion tunnel	6 ft diameter (already under construction)

Table 2.12: Simly Dam Specifications

Construction period: 3 years (start 1971, complete 1973). Cost: **US\$20.5 million** (including coffer dam, tunnel, main dam, small check dams).

Simly Conduction Main Extension:

- Second 36" pipeline, parallel to existing line (PRCC not recommended; use ductile iron or steel)
- Length: 91,000 ft (27.3 km)
- Capacity: 12 mgd per line, total 24 mgd
- Cost: **US\$3.5 million**

Distribution Network (First Stage):

- New distribution mains: 188,000 ft (36" to 8" diameters)
- New service pipes: 150,000 ft (3" to 10")
- Sectors to be served: F-6, F-7, G-6, G-7, E-7, E-8, F-8, E-9, F-9
- Cost: **US\$2.7 million** (escalated to 1980)

Total first stage cost (1971–1980, escalated 4%/annum):

Year	Foreign (US\$)	Local (US\$)	Total (US\$)
1971	1,835,000	2,885,000	4,720,000
1972	7,409,000	4,218,000	11,627,000
1973	6,402,000	5,120,000	11,522,000
1974	1,720,000	2,844,000	4,564,000
1975	533,000	294,000	827,000
1976	278,000	228,000	506,000

Year	Foreign (US\$)	Local (US\$)	Total (US\$)
1977–80	1,189,000	632,000	1,821,000
Total	19,366,000	16,221,000	35,587,000

Table 2.13: First Stage Cost Escalation (1971–1980)

(Plus 1970 rehabilitation: total ≈US\$36.1 million)

2.5.3 Stage III: Second Stage Works (1981–2000)—Khanpur System

Khanpur Dam and Left Bank Canal:

- Khanpur Dam on Haro River (under construction by WAPDA)—earthfill, 167 ft high
- Left Bank Canal: length 57,000 ft from dam to branching point near Nicholson Monument (Grand Trunk Road)
- At branching point: discharge upstream 261 cusecs, downstream 142 cusecs → **119 cusecs available for diversion**
- Allocated for Islamabad water supply: **84 cusecs = 45 mgd**

Proposed Khanpur Filtration Plant:

Feature	Detail
Capacity	45 mgd (in two phases: 22.5 mgd by 1979, 22.5 mgd by 1984)
Intake	From Left Bank Canal at elevation ≈1,779 ft
Raw water transmission	Open canal (2,000 ft) + tunnel (5,000 ft) + pipe (12,000 ft)—gravity
Treatment processes	Pre-chlorination, mixing, flocculation (30 min), inclined-plate sedimentation (1.5 hr), rapid sand filtration (120 m/day), chlorination
Clear water reservoir	1.8 mg (1 hour detention)
Clear water pumping station	6 vertical centrifugal pumps (9 mgd each, 373 ft head, 800 kW), one spare

Feature	Detail
Transmission main to reservoirs	Two 40" steel pipes, length 29,500 ft
Sludge disposal	Discharge to river initially; future recovery possible

Table 2.14: Khanpur Filtration Plant Specifications

Advantages of inclined-plate settlers (Japanese design):

- Detention time 1.5 hours vs. 3–4 hours for conventional
- Higher efficiency (removes particles down to 20 microns vs. 50 microns for conventional)
- Smaller footprint (\approx 60% of conventional)
- Proven technology in Japan (over 200 plants operating by 1970)

Distribution System (Second Stage):

- New distribution mains: 507,000 ft (40" to 8")
- New service pipes: 220,000 ft (3" to 10")
- Three service zones (high, middle, low) based on elevation
- Reservoirs: low service 4.5 mg, middle service 9.0 mg, high service 0.7 mg

Second stage construction cost (escalated to 1985): US\$48.3 million

2.6 Financial Analysis and Water Tariff (1970)

Assumptions:

- Local currency: assumed as grant from Government of Pakistan—no interest, no repayment
- Foreign loans: 5% interest, 20 years repayment including 5 years grace, equal annual installments
- Depreciation: 50 years straight-line for all facilities
- Escalation: 4% per annum for O&M costs
- Unaccounted-for water: reduced from 50% in 1970 to 15% by 2000

Operation and Maintenance Costs (1970–1985, escalated):

Item	Total 16 years (US\$)	Notes
Personnel (increasing from 20 to 72 staff, escalation 4%/yr)	1,737,100	Based on CDA salary scales
Miscellaneous (20% of personnel)	347,420	Office supplies, uniforms, etc.
Repairs (10% of personnel)	173,710	Spare parts, minor repairs
Chemicals (chlorine: US\$0.0066–0.012/gal)	108,303	Based on 2 ppm residual
Electricity (182,500 kWh/year @ US\$0.042–0.076/kWh)	167,000	Pumping only; gravity supply has lower cost
Total O&M	2,533,533	

Table 2.15: Operation and Maintenance Costs (1970–1985)

Interest on Foreign Loans (1971–1985):

- Total foreign loan drawn: US\$19,848,000
- Total interest paid over 20 years: US\$9,944,128 (included in 1971–1985 period)

Total Cost and Unit Cost of Water:

Cost Component	Amount (US\$)
O&M (16 years)	2,533,533
Interest	9,944,128
Depreciation (50 years, annual ≈US\$672,000 over 16 years = 10,752,000)	10,752,000
Total (16 years)	23,229,661

Table 2.16: Total Cost (1970–1985)

Accounted water sales (16 years, 1970–1985): 67,820 million gallons

Unit cost = 23,229,661 / 67,820,000,000 = **US\$0.342 per 1,000 gallons**

At exchange rate US\$1 = Rs. 4.76 → **Rs. 1.63 per 1,000 gallons**

Recommended New Water Tariff:

- **Rs. 1.62 per 1,000 gallons** (rounded)—metered rate
- To be implemented from 1970
- Would cover O&M and depreciation; foreign loan interest separately financed (assumed from soft loans)
- Average household (5 persons, 50 gpcd) would pay ≈Rs. 12 per month—considered affordable (≈1% of average household income)

Cash Flow Forecast (selected years):

Year	Revenue from water sales (US\$)	O&M (US\$)	Net before depreciation (US\$)
1970	467,000	91,000	376,000
1975	1,282,000	187,000	1,095,000
1980	2,046,000	346,000	1,700,000
1985	3,018,000	546,000	2,472,000

Table 2.17: Cash Flow Forecast (1970–1985)

(Revenue calculated at Rs.1.62/1,000 gal, converted at Rs.4.76/US\$)

2.7 Key Conclusions and Recommendations (1970)

Immediate (1970):

1. Repair all visible leaks on Simly conduction main and distribution pipes—cheapest way to gain 2–3 mgd
2. Replace 100 ft of pipe at Gumreh Kas with high-pressure ductile iron pipe to eliminate surge relief valve wasting 0.9 mgd
3. Repair or replace 50% of valves (250 units)—stop leaks and restore network control
4. Rehabilitate all 40,000 house meters (new gear mechanisms from Japan, US\$3 each) and equip meter shop
5. Enforce metered billing at new rate of Rs.1.62/1,000 gal—increase revenue tenfold

Short-term (1971–1973):

- Complete Simly Dam (start immediately) to provide 24 mgd gravity supply

- Build second 36" conduction main parallel to existing line
- Begin laying distribution pipes in developing sectors

Long-term (1974–2000):

- Plan and build Khanpur Filtration Plant (45 mgd in two phases) to meet demand beyond 1980
- Develop new water sources after 1992 as population reaches 768,000
- Continuously reduce unaccounted-for water to 15% by 2000 through leakage control and metering

Financial and Management Recommendations:

- Secure soft foreign loans (Japan is a potential source) and local grants
- Establish a specialised water supply directorate within CDA
- Train personnel in leakage detection, meter repair, and financial management
- Request continued Japanese technical assistance for implementation

2.8 What Happened After 1970? The First Missed Implementation

The 1970 JICA report was comprehensive, urgent, and actionable. But as with Chaudhry’s 1962 report, implementation was partial at best.

Recommendation	Status (as of 2026)
Repair Simly main leaks	Partially done; leaks recurred due to lack of maintenance
Replace 100 ft at Gumreh Kas	Done; surge relief valve eliminated
Replace 250 valves	Not done systematically; many valves still non-functional
Rehabilitate 40,000 meters	Not done; most meters are long since broken
Enforce metered billing	Not done; flat-rate billing continues
Complete Simly Dam	Completed 1982 (9 years behind schedule)
Build second conduction main	Never built
Establish water supply directorate	Done (Water & Sewerage Directorate created)

Recommendation	Status (as of 2026)
Train personnel	Intermittent; no systematic programme
Build Khanpur filtration plant	Completed 2000 (16 years behind schedule)

Table 2.18: Implementation Status of 1970 Recommendations

The Simly Dam was eventually completed—but not until 1982, nine years behind schedule. The second conduction main was never built. The meter repair shop—equipped with Japanese tools—fell into disuse within a few years. The universal metering programme never materialized.¹³

The Khanpur filtration plant, when finally built decades later, did not use the inclined-plate settlers recommended by the Japanese team (detention time 1.5 hours), but conventional sedimentation (3–4 hours), requiring larger land area and higher construction costs. The reasons for this deviation are unclear but likely involved contractor preferences and lack of local familiarity with the technology.

The 50% leakage rate in 1970 remained the 50% leakage rate in 2024.¹⁴

Chapter 3: The Second JICA Survey (1971)—Leakage Control Demonstration

3.1 The Request for Specialised Leakage Control Assistance

The 1970 report had identified leakage control as the most urgent and cost-effective immediate measure. The Government of Pakistan, fully cognizant of the problem, responded immediately by requesting the Japanese Government for a dispatch of another survey team on this particular subject and also for supply of necessary materials.¹⁵

In compliance with this request, the Japanese Government supplied CDA with necessary materials and entrusted the Overseas Technical Cooperation Agency of Japan with the task of field survey.

3.2 The Second Survey Team (January–March 1971)

OTCA organized a second survey team of 7 members headed by Mr. Masanao Masuda, Deputy Chief, Waterworks Section, Environmental Sanitation Bureau, Ministry of Health and Welfare (succeeding Mr. Hasuda as team leader). For a period of three months beginning early January 1971, the team conducted a field survey on the leakage condition of the water supply system by using materials supplied from Japan and, at the same time, undertook necessary repairs.

The team’s terms of reference were to:

- Conduct leakage control and house metering rehabilitation
- Use donated machinery, equipment, and materials
- Cooperate with CDA staff including engineers

- Provide training through demonstration
- Create as-built drawings of existing pipe lines

Through these series of work serving as a demonstration, local engineers were given training on detailed procedure of leakage control programme. The team also conducted a study and made record of existing pipe lines, which should be a valuable contribution to the future operation and maintenance of the system.¹⁶

3.3 The Pilot District: F-6/3

The team selected **Sector F-6/3**, a typical residential district of about 94 houses, covering 0.68 km², for detailed leakage survey. The selection criteria included:

- Representative of Islamabad’s residential sectors (mix of house types)
- Availability of water supply records
- Accessibility for survey work
- Willingness of residents to cooperate

The team conducted:

- Physical inspection of all valves, pipes, and house connections
- Leak detection using sound bars, pipe detectors, and leak detectors
- Flow measurement using a master meter
- Creation of the first accurate “as-built” drawing of the underground network (Figure 1 in the original report)

Key quantitative findings:

Parameter	Finding	Implication
Total valves in the district	105	—
Valves that were functional	Only 52 (49.5%)	Cannot isolate sections for repair or measurement
Valves that leaked or had missing spindles	53 (50.5%)	Direct water loss
Houses without any stop valve	38 out of 94 (40.4%)	Cannot shut off individual houses for repairs

Parameter	Finding	Implication
Houses with a stop valve in imperfect condition	19 out of 56 (34%)	Stop valves that leak or do not close fully
Houses without a water meter	10 (10.6%)	Cannot measure consumption
Water pressure range	0 to 2.9 kg/cm ²	Highly uneven; low pressure in some areas

Table 3.1: Leakage Survey Findings (F-6/3, 1971)

Qualitative findings (direct quotes from the 1971 report):

“At many points where valves were supposed to have been placed, neither valve bodies nor spindles were found but wooden plugs were used to close openings originally left for insertion of valves.”

“Some valves were complete with spindles and valve bodies and yet were not in working condition and others were lacking valve boxes and could not be located at all.”

“No detailed drawings are available for showing such connections.”

“Neither industrial standard nor inspection system for products has been adopted with respect to valves as well as pipes, and this makes even simple repair or replacement extremely difficult.”

“CDA has not enacted any specific provisions for the designation of authorized plumbers, mandatory submission of service pipe drawing, inspection of piping work, etc.”¹⁷

3.4 Equipment Donated by Japan

The Japanese government supplied a comprehensive leakage control kit, which the team catalogued in detail:

Equipment Type	Quantity	Notes
Leak detectors	2	Electronic amplifier with headphones
Pipe detectors	2	Radio frequency pipe locator
Sound detection bars	6	Mechanical listening rods (traditional but effective)

Equipment Type	Quantity	Notes
Pressure gauges and recorders	6	For night-time minimum flow measurement
Woltmann water meters (for district measurement)	2 sets	Portable, 300mm and 400mm
Water meter testing and repair tools	Over 20 items	Including specialized wrenches, jigs, and calibration equipment
Ductile iron pipes (200mm, 250mm, 300mm, 450mm dia.)	10 lengths each	JWA Standard
PVC pipes and jointing tools	15 lengths each 200mm, 250mm	JIS Standard
Epoxy repair compound "Devcon A" (for sealing leaks in cast iron pipes)	50 tubes	Steel-filled epoxy
Cast iron fittings for Woltmann meters	4 sets	JWA Standard

Table 3.2: Equipment Donated by Japan (1971)

3.5 Training Provided

The team conducted **on-site training** for five CDA staff (a deputy director, an assistant engineer, an overseer, and two foremen). Training covered:

1. How to create accurate pipe location drawings:

- Using pipe detectors to trace buried pipes
- Measuring distances from fixed reference points (buildings, roads)
- Recording diameter, material, and depth information
- Drawing to scale (1/500 recommended)

2. How to detect leaks using sound bars and electronic detectors:

- Distinguishing between normal flow noise and leakage noise
- Pinpointing leak location by moving detector along pipe alignment

- Using the sound bar directly on valve spindles and hydrants
- 3. **How to measure night-time minimum flow to estimate leakage volume:**
 - Installing master meters at district inlets
 - Shutting off all consumer stop valves (if functional)
 - Measuring residual flow at 2:00–4:00 AM (minimum consumption period)
- 4. **How to repair leaks using epoxy compounds:**
 - Preparing the pipe surface (cleaning, roughening)
 - Mixing the two-part epoxy
 - Applying and clamping until cured
 - Pressure testing after repair
- 5. **How to test and repair water meters in a dedicated shop:**
 - Setup of the test bench (donated)
 - Calibration procedures
 - Disassembly, cleaning, and replacement of worn parts
 - Reassembly and verification

3.6 The Manual of Leakage Prevention

The team produced a “**Manual of Leakage Prevention in Islamabad Water Supply**” (appended to the report). The manual contained step-by-step procedures for:

- **Chapter 1: Routine leakage detection:** Daily, weekly, and monthly inspection routines; use of listening sticks; recording procedures
- **Chapter 2: Repair of water meters:** Disassembly, cleaning, gear replacement (with part numbers for Japanese-supplied gears), calibration, reassembly
- **Chapter 3: Proper pipe installation:** Trenching, bedding, jointing (including mechanical joints, rubber ring joints, welded joints), backfilling, pressure testing
- **Chapter 4: Making and maintaining distribution pipe drawings:** Scale selection, symbols, referencing, updating procedures
- **Appendix: Equipment maintenance:** Cleaning, storage, calibration schedules for all donated equipment

The manual was written in English, with diagrams and photographs, and was intended for use by CDA staff without Japanese language proficiency.

3.7 The 1971 Recommendations (Still Unfulfilled in 2026)

The report listed five urgent recommendations:

1. **Organize a permanent leakage survey team and a repair team**—to work on a routine schedule. The team recommended a survey team of 3 persons (1 engineer, 2 technicians) and a repair team of 5 persons (1 foreman, 4 labourers), working full-time on leakage control.
2. **Install meters on every service pipe** and test all existing meters on a 5-year cycle. The team noted that the donated repair equipment made this feasible.
3. **Establish a materials inspection shop**—only certified pipes/valves should be used. The shop would pressure-test all materials before installation.
4. **Rehabilitate and extend distribution pipes** based on a redesigned network. The existing network had evolved haphazardly; a systematic redesign was needed.
5. **Complete as-built drawings** for the entire system. The F-6/3 pilot demonstrated that this was possible; it needed to be extended city-wide.

Key sentence from the report: *“These recommendations are all essential for good management of Islamabad water supply.”*¹⁸

3.8 What Happened After 1971?

Despite the clear findings, donated equipment, and trained personnel, **CDA did not institutionalize leakage control.**

The dedicated leakage survey and repair teams were never formed. The meter repair shop fell into disuse within a few years. The as-built drawings were never completed city-wide. The materials inspection shop was never established.

The leakage rate remained essentially unchanged for the next five decades.¹⁹

Chapter 4: The Khanpur Conveyance Blunder (1982–1986)

4.1 The Khanpur Dam: A Major Investment

Khanpur Dam, constructed by WAPDA on the Haro River, was completed in 1983 at a cost of Rs. 1,365 million (approximately US\$140 million at 1983 exchange rates). Its technical specifications:

Parameter	Value
River	Haro
Location	District Hazara, near Khanpur Town
Catchment area	308 sq miles

Parameter	Value
Dam type	Earthen
Height	167 ft
Gross reservoir capacity	106,000 acre-ft
Dead storage	15,500 acre-ft
Live storage	91,500 acre-ft
Life of project	75 years
Mean annual runoff	280,000 acre-ft
Spillway capacity	170,000 cusecs
Spillway gates	5 radial gates, 40' × 35'

Table 4.1: Khanpur Dam Technical Specifications

The dam's average annual yield was 250,000 acre-feet (186 MGD). On 20 October 1972, the Government of Pakistan decided to allocate the dam's water as follows:

Beneficiary	Allocation (MGD)	Notes
Rawalpindi	69	Through WASA and RCB
Islamabad	33	Through CDA
Other beneficiaries (Wah, Taxila, irrigation)	84	Industrial and agricultural
Total	186	Full dam yield

Table 4.2: Khanpur Dam Water Allocation (1972)

By 1983, with the dam nearing completion, the government requested Japanese technical and financial assistance for the conduction of water from Khanpur to the twin cities.

4.2 The Three Conveyance Alternatives

JICA carried out a detailed feasibility study on the conduction of water from Khanpur to Rawalpindi/Islamabad in 1983–1984. Three alternatives were evaluated with exhaustive cost-benefit analysis:

Alternative I: Nicholson Monument Route

- Water available at RL 1766 ft via existing Left Bank Canal (constructed by WAPDA)
- RCC conduit (2,500 ft) → raw water reservoir (5-day storage, 625 MG) → treatment plant (125 MG) → pumping to RL 1980 ft
- Rawalpindi receives gravity supply; 50% of Islamabad's supply requires pumping to high-altitude reservoir

Detailed cost breakdown (Rs. 1000):

Item	Amount
R.C. conduit (D=8 ft, 2500 ft)	12,500
Raw water reservoir	62,500
Treatment plant	312,000
Pumping stations (multiple pumps)	113,000
Steel pipelines (various sizes)	~233,000
Regulating tanks	16,000
Service reservoirs	76,500
Sub-total	840,000
Engineering & admin (15%)	130,000
Contingency (15%)	150,000
Total	1,120,000

Table 4.3: Alternative I Cost Breakdown

Performance:

- Annual O&M: Rs. 81.91 million (including Rs. 39.52 million for electricity)
- Cost per 1000 gallons: Rs. 3.72
- **Major drawback: high energy consumption (260 ft head for main pumps)**

Alternative II: Short Tunnel (Khanpur to Shah Allah Ditta)

- Intake tower at Khanpur (caisson method) → pump to Choi plain (RL 2130 ft) → RCC gravity conduit (14,000 ft) → horseshoe tunnel (16,000 ft, 8 ft dia) → treatment plant at Shah Allah Ditta (southern side of Margalla Hills)
- Rawalpindi: full gravity; Islamabad: ≈90% gravity, 10% pumped to high zones

Detailed cost breakdown (Rs. 1000):

Item	Amount
Intake tower (caisson)	25,000
Pressure tunnel (1,000 ft)	10,000
Long tunnel (16,280 ft)	296,000? (note: tables vary)
Treatment plant (102 MG)	312,500
Pumping stations	32,500 + 15,000 + 16,500
Pipelines	~98,000
Service reservoirs	76,500
Sub-total	910,000
Engineering & admin (15%)	140,000
Contingency (15%)	160,000
Total	1,210,000 (or 1,380 according to other tables)

Table 4.4: Alternative II Cost Breakdown

Note: Discrepancy exists between different cost tables in the report (PC-1 shows Rs. 1,380 million for Alternative II). The more detailed breakdown gives Rs. 1,210 million.

Performance:

- Annual O&M: Rs. 68.36 million (electricity Rs. 31.40 million)
- Cost per 1000 gallons: Rs. 3.22
- **Drawback: only economical if restricted to Islamabad alone; not optimal for joint facilities**

Alternative III: Long Tunnel (Khanpur to Golra)—PREFERRED BY JICA

- Intake tower at Khanpur (caisson method) → pressure tunnel (1,000 ft) → long tunnel (37,000 ft, horseshoe section, 8.5 ft dia) → treatment plant near Golra village (south of Margalla Hills)
- Rawalpindi: mostly gravity; Islamabad: ≈20 MGD pumped against 200 ft head

Detailed cost breakdown (Rs. 1000):

Component	Quantity	Amount
Intake tower (caisson)	LS	25,000
Pressure tunnel (D=8 ft)	1,000 ft	10,000
Control valves (1500mm)	2 units	500
Long tunnel (8.5 ft horseshoe)	37,000 ft	296,000
Shaft (15 ft dia)	400 ft	600
Raw water reservoir & treatment plant	125 MG	312,500
Pumping stations (5+3+3 pumps)	—	64,000
Steel pipelines (various)	—	98,560
Service reservoirs (Islamabad low/high, Rawalpindi low/high)	—	76,500

Component	Quantity	Amount
Miscellaneous	—	13,840
Sub-total		910,000
Engineering & admin (15%)		140,000
Contingency (15%)		160,000
TOTAL		1,210,000

Table 4.5: Alternative III Cost Breakdown

Pipeline details (Alternative III):

Pipe description	Length (ft)	Tonnage	Cost (Rs. 1000)
1200mm, t=12mm, pressure	6,000 (1 line)	660	10,560
900mm, t=9mm, pressure	2,000 (1 line)	120	1,920
1200mm, t=11mm, gravity	17,000 (2 lines)	3,400	54,400
1200mm, t=12mm, pressure	18,000 (1 line)	1,980	31,680

Table 4.6: Alternative III Pipeline Details

Service reservoirs (Alternative III):

Reservoir	Capacity (MG)	Cost (Rs. 1000)
Islamabad low water zone	5.0	12,500
Islamabad high water zone	4.8	12,000
Rawalpindi low water zone	15.0	37,500

Reservoir	Capacity (MG)	Cost (Rs. 1000)
Rawalpindi high water zone	4.8	14,500

Table 4.7: Alternative III Service Reservoirs

Advantages:

- Minimal pumping head → lowest electricity consumption
- Best suited for joint facilities and long-term energy cost savings
- Aligns with global energy crisis mitigation (early 1980s oil price shocks)

Comparative table of the three alternatives:

Alternative	Construction cost (Rs. million)	O&M cost/year (Rs. million)	Time of construction	Annual energy consumption (million KWh)
I	1,917	86	5 years	65.34
II	1,971	63	5 years	59.3
III	1,726	47	6 years	26.06

Table 4.8: Comparison of Three Conveyance Alternatives

4.3 The Expert Consensus for Alternative III

The consensus among technical experts was overwhelming:

- **JICA** recommended Alternate III as the most economical from operations and maintenance perspective
- **CDA** agreed with JICA recommendations
- **WAPDA** (after conducting its own appraisal) recommended that Alternate-III would save approximately Rs.53 million in O&M cost and about 39 million KWh of energy yearly compared with Alternate-I
- **Ministry of Water and Power** vetted WAPDA’s recommendations
- **Planning Commission** supported the long tunnel option

The case was referred to the Executive Committee of the National Economic Council (ECNEC)—the highest economic decision-making body in the country—for final approval.

4.4 The Fatal ECNEC Decision (19 April 1986)

*“Finally the two alternatives for conveyance of water from Khanpur to Islamabad/Rawalpindi were discussed in the ECNEC meeting held on 19th April 1986 and it was decided that alternative—I i.e. treatment plant at Nicholson monument and subsequent pumping to Islamabad and Rawalpindi be adopted as it will take only five year to complete the project while alternative III would take six year.”*²⁰

Political pressure, not technical merit, determined the decision. The residents of Rawalpindi “could not wait another year.” Punjab government officials lobbied hard for the canal option, which was already partially constructed. The one-year time saving was prioritized over fifty years of higher operating costs and energy consumption.

The irony: The tunnel option had a longer construction time primarily because it required boring through the Margalla Hills—a technically challenging but entirely feasible task. WAPDA had already constructed a 3 km tunnel on the right bank of Khanpur Dam, demonstrating that the capability existed. The additional year was a small price to pay for decades of lower operating costs.

4.5 The Consequences: A Technical and Financial Disaster

The decision to use the tail end of the Left Bank Canal for water supply proved catastrophic:

Conveyance losses: WAPDA releases 51 MGD from Khanpur Dam for the twin cities (the full 33 MGD for Islamabad plus 18 MGD for Rawalpindi), but CDA receives only 28 MGD at its reservoir in Sangjani—a **25–30% loss** before water even enters the CDA’s storage.²¹

Seepage: The Left Bank Canal cannot intake more than 240 cusecs of water from Khanpur reservoir against the designed capacity of 440 cusecs, due to design and construction faults of the siphons and aqueducts (as reported by Nippon Jogesuido Sekkei Co. Ltd of Japan, a consulting firm retained by WAPDA).

Siltation: Water quality at the tail-end of the canal is much degraded compared to original Khanpur reservoir, requiring expensive filtration. The canal carries sediment that settles in the Sangjani treatment plant’s sedimentation basins, requiring frequent cleaning.

Energy costs: WAPDA’s electric bill for pumping exceeds Rs. 84 million per annum. This cost is borne by CDA and the Rawalpindi water agencies, and ultimately by consumers.²²

The final results (as of 2005):

Service Area	Design Supply Capacity (MGD)	Actual Supply (MGD)	Shortfall
CDA (Islamabad)	17	9	47%
WASA Rawalpindi	14.6	6	59%
RCB Rawalpindi	19.4	8	59%

Service Area	Design Supply Capacity (MGD)	Actual Supply (MGD)	Shortfall
Total	51	23	55%

Table 4.9: Khanpur Water Supply—Design vs. Actual

The dam yielded abundantly—but the conveyance system failed. In 2005 alone, 20,266.47 million gallons of water spilled over from Khanpur reservoir (indicating that the dam was full), but production from Sangjani never exceeded 23 MGD. The rest flowed down the Haro River to Tarbela Dam, or seeped into the ground along the canal alignment.²³

4.6 The Irony: A Tunnel Design Already Complete

JICA had already completed the detailed design for the long tunnel in 1985. The design included:

- Tunnel alignment (37,000 ft through the Margalla Hills)
- Cross-section (8.5 ft horseshoe, suitable for both gravity flow and maintenance access)
- Shaft locations (400 ft deep at the western portal)
- Intake structure (caisson method, already proven at Khanpur)

The tunnel would have:

- Eliminated pumping costs entirely (gravity supply from dam to treatment plant)
- Reduced O&M costs by ≈Rs. 39 million per year compared to the chosen option
- Saved 39 million KWh of electricity annually (enough to power 3,000 homes)
- Delivered the full 51 MGD design capacity (no canal losses)

The one-year construction time difference was a false economy. The additional O&M costs incurred over the first ten years of operation exceeded the entire capital cost difference between the two options.

4.7 The 2024 Recognition of Failure

In November 2024—38 years after the fatal ECNEC decision—city managers finally decided to carry out a joint survey of the 18 km Khanpur Dam canal to address leakage and water theft. The CDA chairman directed that a joint survey be carried out by the Khyber Pakhtunkhwa and Punjab irrigation departments, RCB, Wasa Rawalpindi, and CDA.

A CDA document noted: *“WAPDA releases 51 million gallons per day for the CDA from Khanpur Dam (for both Islamabad and Rawalpindi) but the civic body received only 28 MGD as water was being used through unfair means before it reached CDA’s reservoir in Sangjani.”*²⁴

The tunnel that should have been built in 1986 is still being debated in 2026. Four decades of lost water, wasted energy, and foregone revenue cannot be recovered.

VOLUME TWO: GROUNDWATER RESOURCES (1988–2024)

Chapter 5: The JICA Groundwater Master Plan (1988)

5.1 The Regional Study

In 1988, JICA completed the “Regional Study for Water Resources Development Potential for the Metropolitan Area of Islamabad-Rawalpindi”—a comprehensive master plan targeting the year 2010, with outlook to 2030.²⁵

The study was unprecedented in scope. It assembled data from:

- 59 existing and exploratory boreholes
- 350 electrical resistivity soundings (predecessor to the PCRWR study)
- 6 years of rainfall records from 22 stations
- 12 years of river flow data from 8 gauging stations
- 15 years of groundwater level records from 45 observation wells

The study’s primary conclusion was that existing and then-currently planned sources (including the newly completed Khanpur Dam) would be insufficient to meet long-term demand.

Consequently, the plan proposed a **staged, multi-pronged development of new water resources** up to the year 2030, focusing heavily on new storage dams, supported by diversion weirs, pumping stations, and conveyance systems. The total estimated investment cost was Rs. 16,500 million (1987 rates).

5.2 Population and Demand Projections (1988)

The study projected water demands for the target years of 2000, 2010, and 2030. Urban water demand (MCM/year):

Year	Islamabad	Rawalpindi	Total
2000	140.7	227.4	368.1
2010	190.0	304.0	494.0
2030	222.0	344.4	566.4

Table 5.1: Urban Water Demand Projections (1988 JICA)

Irrigation water demand (MCM/year):

Year	Left Bank Canal	Right Bank Canal	Total
2000	24.3	17.7	42.0

Year	Left Bank Canal	Right Bank Canal	Total
2010	48.6	35.4	84.0
2030	48.6	35.4	84.0

Table 5.2: Irrigation Water Demand Projections (1988 JICA)

Total water demand (MCM/year):

Year	Total
2000	410.1
2010	578.0
2030	650.4

Table 5.3: Total Water Demand Projections (1988 JICA)

5.3 The Supply-Demand Gap

Comparing available sources (existing and planned) with projected demand:

Year	Available Supply (MCM/year)	Demand (MCM/year)	Gap (MCM/year)
2000	410.1	410.1	0
2010	514.0	578.0	-64.0
2030	514.0	650.4	-136.4

Table 5.4: Supply-Demand Gap (1988 JICA)

Key finding: Even with Khanpur Dam and all existing sources, the system would be in deficit from 2010 onwards. New sources were essential.

5.4 The To-Do List: Recommended New Storage Dams

The study evaluated seven potential dam sites across the Haro, Soan, and Dor river basins. The evaluation included:

- Topographic surveys (preliminary)

- Geological assessments (based on existing maps and limited field work)
- Hydrological analysis (using regional rainfall-runoff relationships)
- Economic analysis (unit water cost optimization)

Using a “Unit Water Cost” optimization model, the following dams were recommended for construction:

Dam Name	River/Area	Recommended Annual Production (MCM)	Unit Cost (Rs./1,000 m ³)	Key Note
D-1 (Rajola)	Dor River	107	Lowest	Most cost-effective, largest proposed new source
S-1 (Cherah)	Soan Basin	60	Low	Submergence of Cherah village is a key constraint
L-1 (Dadhochai)	Soan Basin	70	Medium	High unit cost compared to D-1, S-1
KL-1 (Lohi Bher)	Soan Basin	34	Low	Smaller scale scheme
SL-1 (Dhok Shaban / Sil Kas)	Soan Basin	40	Low-Medium	—
H-4 (Pina)	Haro Basin	80	Medium	Related to Khanpur system
Shahpur Heightening	Existing Dam	17.3	Low	Raising the existing Shahpur Dam

Table 5.5: Recommended New Storage Dams (1988 JICA)

5.5 The Dor River: The Most Promising New Source

The Dor River is a tributary of the Indus River, located northeast of the metropolitan area. Its catchment area (within the study region) is approximately 600 km². The river flows through relatively hard, compact Precambrian to Paleozoic rocks, providing good foundation conditions for dams and relatively high-quality runoff.

Key findings on the Dor River:

- Recommended annual production: **107 MCM** (≈16% of total new water production)
- Recommended effective storage capacity: 60 MCM
- Ranked most cost-effective among all proposed dams
- Lowest unit water cost among seven potential dam sites
- Multi-purpose (urban water supply for twin cities + irrigation)
- Implementation phase: Third Phase (by 2030)

Transbasin diversion potential: The Dor River flows into the Indus upstream of Tarbela Dam. The study proposed a Dor Transbasin Conduction scheme to divert Dor water toward the metropolitan area. Estimated cost for the Dor canal system (including a diversion dam and canal) was Rs. 2,007 million (1987 prices), with annual O&M of Rs. 16.4 million.

Comparison with alternatives:

Scheme	Total Construction Cost (Rs. million)	Annual O&M (Rs. million)	Notes
Dor Canal	2,007	16.4	Shorter distance, lower lift
Jhelum Canal	2,096	71.0	Longer distance, higher lift
Tarbela (Indus) Canal	2,685	94.0	Longest distance, highest lift

Table 5.6: Comparison of Transbasin Conduction Schemes

The Dor scheme was the cheapest to construct and had the lowest operating cost.²⁶

5.6 The Siran River: Not Evaluated

The **Siran River is not mentioned** in any of the 1988 JICA volumes (main report, appendices, or executive summary). The study focused on the Dor, Haro, and Soan river basins because they are the closest perennial sources to the metropolitan area.

Other sources indicate that the Siran River:

- Originates in Khyber Pakhtunkhwa province, approximately 50 km north of Islamabad

- Shows increasing fecal pollution and heavy metal contamination, especially downstream of Mansehra city
- Is the subject of a 2017 JICA survey for a gravity flow water supply scheme to supply drinking water to **Mansehra and its suburbs**, but **not for Islamabad**

The Siran River was not considered a viable source for CDA in the 1988 master plan.

5.7 The Staged Development Plan (1988–2030)

The study proposed a phased development over 43 years:

1st Phase (up to 2000): Focus on completing the Khanpur Conduction project and starting feasibility/design of the Cherah (S-1) and Sil Kas (SL-1) dams.

2nd Phase (up to 2010): Complete KL-1 dam and start construction of SL-1 dam.

3rd Phase (up to 2030): Complete the remaining major dams (D-1, H-4, etc.) to meet the ultimate demand.

Water balance by phase (MCM/year):

Source Type	1987 (Present)	2000 (1st Phase)	2010 (2nd Phase)	2030 (3rd Phase)	Total (2030)
Storage Dams	136.5	173.5	91.3	257.0	658.3
Diversion Dams	15.1	83.6	—	—	98.7
Tubewells	99.3	29.4	5.4	0.8	134.9
Total	250.9	286.5	96.7	257.8	891.9

Table 5.7: Phased Water Balance (MCM/year)

The **257.0 MCM from storage dams in the third phase** includes the D-1 (Rajola) dam on the Dor River (107 MCM) along with other dams like H-4 (Pina) and possibly additional capacity.

5.8 Organizational Recommendation

The study strongly recommended a major organizational reform:

“The existing separate agencies (CDA for Islamabad, PHED for Rawalpindi) should eventually be merged into a single, powerful entity called the Metropolitan Water Supply and Sewerage Board (MWSSB). This board would be financially independent and responsible for all bulk water supply, distribution, and sewerage for a unified ‘Greater Islamabad.’”²⁷

The report noted that the fragmented institutional structure was a major obstacle to integrated water management. CDA had jurisdiction only within the ICT boundary, but water sources (Khanpur Dam, Rawal Dam) lay outside. PHED (Punjab) controlled Rawalpindi’s water. WAPDA operated the dams. No single entity had end-to-end responsibility.

This recommendation—like so many others—has never been implemented.

Chapter 6: Groundwater Assessment (2023–2024)

6.1 The PCRWR Comprehensive Study (2023)

In 2023, the Pakistan Council of Research in Water Resources (PCRWR) published “Hydrological Assessment of Surface and Groundwater Resources of Islamabad, Pakistan”—the most comprehensive groundwater study since the JICA era.²⁸

Methodology:

- 350 Electrical Resistivity Soundings (ERS), covering depths up to 300 m
- 309 depth-to-water table measurements (1 km × 1 km grid in urban sectors, 2 km × 2 km in rural areas)
- 309 physicochemical samples + 122 microbiological samples
- 402 isotope samples ($\delta^{18}\text{O}$ and $\delta^2\text{H}$) for recharge source identification

6.2 Depth to Water Table (DTW)—The Shocking Depletion

Key findings:

Parameter	Value
Range	15 m to >100 m
Average	35–40 m
Shallowest	Along Margalla foothills (sectors E, F, G)—typically 15–25 m
Deepest	Sectors H-8, H-9, I-8, I-9, I-10—DTW reaches 50–60 m
Outside main aquifer (e.g., G-13, G-14)	DTW exceeds 100 m; perched aquifers with very limited potential

Table 6.1: Depth to Water Table Findings

Seasonal fluctuation: Pre-monsoon (May-June) water table is lowest due to pumping; post-monsoon (September-October) recovery of 1–3 m occurs.

Long-term trend: Depletion at ≈ 1 m/year in urban areas.²⁹

Comparison with historical data:

Location	Earlier Depth	Year	Recent Depth	Year	Change
Islamabad	22.8 m	(Previous study)	56 m	(Recent study)	+146%
Rawalpindi City	37.8 m	(Previous study)	59 m	(Recent study)	+56%

Table 6.2: Groundwater Table Decline Over Time

The aquifer has lost more than half its accessible storage in a single generation.

6.3 Groundwater Potential Mapping

Resistivity–potential classification (calibrated against 290 borehole logs):

Resistivity (ohm-m)	Groundwater Potential	Typical Lithology
<20	Very limited	Clay/shale (impermeable)
20–30	Limited	Clay with minor sand/gravel
30–35	Moderate	Alternate bedding of clay and gravel
35–200	Good	Gravel and boulder (high permeability)
>200	Bedrock	Hard rock (no groundwater)

Table 6.3: Resistivity–Potential Classification

Groundwater potential at various depths:

Depth	% Area (Good to Moderate Potential)	Key Observations
25 m	≈30%	Groundwater available only near Margalla hills and Rawal Dam area; most area has clay/shale (low resistivity)
50 m	≈50%	Depth to water table reaches 50 m; good potential appears in patches (Shehzad Town, Rawat)
100 m	≈60%	Significant increase; gravel/boulder layers present; sectors G, H, I still limited due to clay
150 m	63%	Maximum coverage of moderate to good potential. Rural areas show deep aquifers
200 m	≈60%	Similar to 150 m; sectoral areas remain limited
300 m	≈58%	No major change; deep aquifer extends beyond 300 m in some rural zones

Table 6.4: Groundwater Potential by Depth

Active groundwater storage (0–300 m depth, moderate-good zones):

- Area covered: **520 km²** (about 75% of ICT)
- Average specific yield (assumed from pumping tests): 0.14
- **Active storage = 7.5 billion cubic metres (BCM)**

This is enough water to meet Islamabad’s current demand for approximately 150 years—if extracted sustainably. The key word is “sustainably.”

6.4 Aquifer Lithology and Cross-Section

A north-south cross-section (A-A’) from Margalla Hills to Faizabad revealed the aquifer’s three-layer structure:

North (Margalla foothills):

- Clay/shale layer: <10 m thick
- Underlying gravel and boulders: high permeability
- **Result: good natural recharge, shallow water table**

Mid-area (sectors G, H, I):

- Clay/shale thickness increases to 25–40 m
- Restricts vertical recharge from rainfall
- Deeper gravel layers (below 50–100 m) provide moderate potential
- **Result: water table deeper (50–60 m), limited natural recharge**

South (Faizabad area):

- Clay/shale sequences ≥ 50 m thick
- Occasional gravel interbeds only
- Groundwater very limited
- CDA has installed deep tube wells (Poona Faqiran) to tap deeper aquifers
- **Result: water table very deep, pumping expensive**

The **1988 JICA hydrogeological map** overlays with current potential maps; it confirms that the original shallow aquifer (within 50 m) has been depleted in many sectors.³⁰

6.5 Groundwater Recharge Sources (Isotopic Analysis)

The 402 isotope samples ($\delta^{18}\text{O}$ and $\delta^2\text{H}$) provided definitive evidence of recharge sources:

Recharge Source	Contribution	Evidence
Rainfall	Dominant ($\approx 80\text{--}90\%$)	Isotopic signature matches local rainfall
Streams	Minor ($\approx 10\text{--}20\%$)	Localized near Margalla foothills
Evaporation signature	Some samples show enrichment	Indicates recharge from surface water bodies or irrigation return flow

Table 6.5: Groundwater Recharge Sources

Modern recharge: Tritium and carbon-14 dating indicate groundwater is mostly of **recent age** (last 50–60 years), meaning the aquifer is responsive to current rainfall patterns. This is good news—it means that managed aquifer recharge can work.

6.6 Groundwater Quality—A Mixed Picture

Physicochemical quality:

Parameter	Average	Range	% Exceeding NSDWQ	NSDWQ Limit
TDS (mg/L)	690.4	207.6–7,938	<1%	1000
Hardness (mg/L)	476.6	110–2,310	9%	500
Nitrate (mg/L as N)	8.2	0–104	6%	10
pH	7.0	6.7–8.3	<1%	6.5–8.5

Table 6.6: Physicochemical Water Quality

Note on TDS maximum: The 7,938 mg/L sample was an outlier from a shallow well in an area with high evaporation; typical TDS is 200–700 mg/L.

Microbiological quality (critical finding):

- **Of 122 groundwater samples (2023 study): 85% were contaminated with total coliforms and/or E. coli**
- **In the June 2024 tube well survey (127 CDA tube wells): 83% safe, 17% unsafe—the discrepancy arises because the 2024 survey included only operational CDA wells, many of which are chlorinated; the 2023 survey included private boreholes and rural wells without treatment**

Sector-wise tube well safety (2024):

- I-Sector: 32/35 (91%) safe
- G-Sector: 21/25 (84%) safe
- H-Sector: 11/14 (79%) safe
- F-Sector: 16/23 (70%) safe
- Rural water supply schemes: only 20% safe (80% unsafe due to bacterial contamination)

Main causes of contamination:

- Inadequate sanitary protection of wells (no concrete aprons, open tops)
- Leaking sewage networks and septic tanks (especially in older sectors)
- Absence of regular chlorination and monitoring
- Shallow wells drawing from contaminated near-surface aquifers

6.7 Groundwater Abstraction and Balance

Component	Volume (MCM/year)	Notes
CDA tube wells (190 wells)	47	Based on pump discharge records
Private wells (estimated)	30–40	Not metered; rough estimate
Total abstraction	77–87	
Natural recharge (estimated from rainfall)	50–60	Based on rainfall 1,303 mm/year × 906 km ² × 0.05 recharge coefficient
Deficit	27–30	

Table 6.7: Groundwater Abstraction vs. Recharge

Deficit of 30–40 MCM/year → observed water table decline of 1 m/year.³¹

6.8 Managed Aquifer Recharge (MAR) Initiatives

In response to depletion, PCRWR and CDA launched a **rainwater harvesting for groundwater recharge project** in 2021:

Parameter	Value
Recharge wells installed	100 (sectors H-8, H-9, I-8, I-9, I-10)
Rainwater harvested (June 2022 – August 2023)	≈72 million gallons (0.27 MCM)
Local water table rise	Up to 1 metre observed near recharge wells

Table 6.8: MAR Initiative Results

Scaling up required: To balance current abstraction (≈47 MCM/year from CDA wells alone), only 17% of the available surface runoff (275 MCM/year) would need to be harvested—a feasible target.

The pilot proves that MAR works. What is needed is scale.

Chapter 7: The PCRWR Water Quality Monitoring (2024)

7.1 Drinking Water Sources Assessment

In June 2024, PCRWR assessed 288 drinking water sources in Islamabad:

Source Type	Total	Safe	% Safe	Unsafe	% Unsafe
Tube Wells	127	105	83%	22	17%
Water Filtration Plants	108	69	64%	39	36%
Water Supply Schemes	41	8	20%	33	80%
Water Works	12	7	58%	5	42%
Total	288	189	66%	99	34%

Table 7.1: Drinking Water Sources Assessment (June 2024)

7.2 Stream Water Quality: A Pollution Crisis

Water samples from 31 stream locations were analysed against NEQS (2000) effluent standards. The results are alarming:

Parameter	Non-Compliance Rate	NEQS Limit	Key Finding
Dissolved Oxygen (DO)	74% of sites below 3 mg/L	3 mg/L minimum	Lowest at Niki Lai Terminal Point: 0.2 mg/L—extreme pollution
Chemical Oxygen Demand (COD)	48% exceed 150 mg/L	150 mg/L	Highest at Niki Lai: 710 mg/L
Biochemical Oxygen Demand (BOD)	48% exceed 80 mg/L	80 mg/L	Highest at Niki Lai: 655 mg/L
Total Suspended Solids (TSS)	19% exceed 200 mg/L	200 mg/L	Highest at Niki Lai: 370 mg/L

Parameter	Non-Compliance Rate	NEQS Limit	Key Finding
Oil and Grease	10% exceed 10 mg/L	10 mg/L	Korang River: 15 mg/L
Total Nitrogen	45% exceed 10 mg/L	10 mg/L	Highest at Korang River: 24.65 mg/L

Table 7.2: Stream Water Quality Non-Compliance

Interpretation:

- **DO below 3 mg/L:** Hypoxic conditions that cannot support most aquatic life
- **COD and BOD high:** Indicates massive organic pollution (sewage, industrial waste)
- **TSS high:** Sediment from construction sites and erosion
- **Oil and grease:** Urban runoff from roads and parking lots
- **Total nitrogen:** Fertilizers and sewage

Cumulative flow from ICT: Increased from 5,332 lps (0.46 MCM) in January 2024 to 6,953 lps (0.6 MCM) in June 2024—a 30% rise due to increased water use during summer months.³²

7.3 Health Implications

Contaminant	Health Impact	Vulnerable Population
Microbiological (Total Coliforms, E. coli)	Gastro-enteritis, Cholera, Diarrhea, Dysentery, Hepatitis A & E, Typhoid	Children, elderly, immunocompromised
Nitrate	Methemoglobinemia (“Blue Baby Syndrome”)—reduced oxygen-carrying capacity	Infants under 6 months
Turbidity	Can protect microorganisms from disinfection effects; stimulates bacterial growth	All consumers

Table 7.3: Health Implications of Contaminants

The streams that flow through Islamabad are not just polluted—they are public health hazards. Water from these streams seeps into the aquifer, contaminating groundwater that is then pumped for drinking.

VOLUME FOUR: LEAKAGE AND NON-REVENUE WATER (1971–2025)

Chapter 8: The 50% Leakage—A 54-Year Failure

8.1 The Persistent Problem

In 1971, the JICA leakage survey found that **50% of valves in the pilot district were non-functional**, and **estimated total unaccounted-for water at 50% of production**.

In 2024, CDA’s Director General of Water Management admitted that “seepage and theft currently results in a 40 to 50 percent water loss.”³³

The leakage rate has remained essentially unchanged for 54 years.

8.2 Conveyance Losses (Source to City)

Segment	Loss	Source
WAPDA release vs. CDA receipt at Sangjani	25–30%	CDA documents
Simply old pipeline leakage	≥30% of flow	1999 JBIC evaluation
Khanpur Left Bank Canal	Estimated 30% due to seepage and theft	2024 CDA survey

Table 8.1: Conveyance Losses

8.3 Distribution Losses (Within City)

Year	Reported Loss	Source
1971	50% (in pilot district)	JICA leakage survey
2008	40% of total city water	CDA official
2024	40–50%	CDA Director General

Table 8.2: Distribution Losses Over Time

8.4 Financial Impact of Leakage

At a conservative water charge of Rs. 4 per 1,000 gallons, 111 MGD lost represents **over Rs. 160 million per year** in foregone revenue—not counting the cost of pumping and treating that water.

Over 54 years, the cumulative lost revenue is in the billions of rupees.

8.5 Why Has Leakage Persisted?

Institutional failure:

- No permanent leakage control cell created
- High staff turnover; trained personnel from 1971 retired without transferring knowledge
- No performance metrics for NRW

Financial disincentives:

- Flat-rate billing means CDA collects same revenue regardless of leakage
- Subsidized water means no incentive to reduce costs
- Donor funding favours new dams over leakage reduction

Technical factors:

- Aging PRCC pipes (condemned in 1971) still in service
- No valve maintenance
- Illegal connections thrive in unmetered system

Political factors:

- Water theft tolerated (influential individuals have illegal connections)
- No accountability for high NRW
- Short-term thinking (leak repair is invisible; new dams get ribbon cuttings)

VOLUME FIVE: WATERSHED PROTECTION (1962–2025)

Chapter 9: The Forgotten Forest

9.1 The International Evidence

The 2003 WWF/World Bank report *Running Pure* documented that **around a third (33 out of 105) of the world's largest cities obtain a significant proportion of their drinking water directly from protected areas.**

Case studies:

City	Protected Area	IUCN Category	Outcome
New York	Catskill State Park	V	Avoided US\$6–8 billion filtration plant
Melbourne	Yarra Ranges National Park	II	Highest quality drinking water in Australia
Singapore	Bukit Timah/Central Catchment	IV	Original purpose was water protection
Tokyo	Nikko and Chichibu-Tama National Parks	V	Headwaters of major river systems
Karachi	Kirthar National Park, Hub Dam Wildlife Sanctuary	II, IV	Significant part of catchment protected

Table 9.1: International Watershed Protection Examples

Pakistan has a precedent for using protected areas for water supply—but not in Islamabad.³⁴

9.2 The Islamabad Failure

Simly Dam Catchment:

- A 2017 news report stated the government planned to adopt “watershed management practices...including plantation of trees, increasing vegetative cover and construction of check dams” due to a 7% loss in usable storage from silting
- **No evidence this plan has been fully implemented in the nine years since**

Rawal Dam Catchment:

- Responsibility is divided between CDA, WASA Rawalpindi, Punjab government, and KP government
- Solutions discussed are crisis-driven: sewage treatment plants, cleaning solid waste, restoring wetlands
- **No comprehensive “watershed protection plan” exists**

Khanpur Dam Catchment:

- Focus is technical and downstream: leakage surveys, new pipelines
- **No mention of upstream forest catchment protection**

Margalla Hills National Park:

- CDA is nominally responsible for protecting the park
- **No explicit link made between park protection and water supply quality**

9.3 The 54-Year Legacy of Inaction

The story of Islamabad’s water supply is a stark example of the “tragedy of the commons,” where fractured jurisdiction and a lack of political will have allowed a preventable crisis to worsen. The CDA has the tools and the responsibility; it has had a watershed protection unit for Simly Dam for years, and its officials know about the pollution in Rawal Dam. Internationally, models exist for success.

Inaction is a choice—and it’s a choice that has come at a tremendous cost.³⁵

VOLUME SIX: METERING AND REVENUE

Chapter 10: The Missing Meters

10.1 The British Colonial Precedent: Meters First Came to Pakistan

Murree holds the distinction of being among the first locations in South Asia to have a metered water supply. The British Indian Army established a water supply scheme in Donga Gali between 1890–1894 specifically for troops deployed in Murree.

Abbottabad was founded in 1863 and, like Murree, was developed as a colonial hill station with a metered water supply.

If the British could install water meters in the 1890s, why can’t Pakistan do it now?³⁶

10.2 The 1970 Findings

The 1970 JICA survey found:

- 10,248 Polish meters installed, **55% out of order**
- No meter reading ever done; flat-rate billing based on house type
- Revenue from water charges was only Rs. 427,981 in 1969–70
- Theoretical metered revenue: ≈Rs. 4 million—a **tenfold gap**

10.3 The 2007 CDA Metering Project

In 2007, CDA approved a PC-II amounting to Rs. 295.362 million for “Reconstruction / Rehabilitation and capacity building of existing water supply network—metered supply strategy.”³⁷

Three stages of implementation:

- Stage I: Pre-Construction
- Stage II: Construction Supervision
- Stage III: Operation & Maintenance

Nine consultancy firms submitted Expressions of Interest. Draft contract documents and Terms of Reference were vetted by the Law Directorate.

The project never materialized.

10.4 The 2025 Announcement

In October 2025, CDA formally approved a Water Metering Project, stating it would “serve as a benchmark for efficient urban water management in Pakistan.”

No timeline for completion has been announced. Skepticism remains high given CDA’s poor track record.³⁸

10.5 Why CDA Has No Metering System

Historical design flaw: When the city was built in the 1960s, water meters were simply “not a part of its design blueprint.”

Political resistance: Water metering is politically unpopular because it would require consumers to start paying for actual usage rather than a flat rate.

Vested interests: Powerful interests benefit from unmetered water—illegal connections and water theft thrive in an unmetered system.

10.6 The Vicious Cycle

The absence of metering has created a self-reinforcing cycle:

- Without meters, customers have no incentive to conserve
- Without meters, the utility cannot generate revenue to invest in infrastructure
- Without revenue, the system deteriorates further
- As the system deteriorates, leakage increases
- As leakage increases, water shortage worsens

10.7 The Annual Cost of Inaction

Impact	Magnitude
Financial loss (40–50% NRW)	Over Rs. 160 million/year in foregone revenue
Resource depletion	Wasted water enough to meet the needs of nearly 500,000 people annually
Environmental damage	Groundwater table dropping 1 metre per year

Table 10.1: Annual Cost of Inaction

Chapter 11: Foundational Principles

This doctrine is built on the following principles, derived from six decades of accumulated evidence:

Principle 1: Water is a finite and exhaustible resource. The aquifer beneath Islamabad is being depleted at 1 m/year. This is unsustainable.

Principle 2: Leakage control is the cheapest source of “new” water. Every million gallons saved through leakage repair costs a fraction of developing a new million gallons of supply.

Principle 3: Metering is essential for both conservation and revenue. Without meters, there is no accountability—for the utility or the consumer.

Principle 4: Watershed protection is infrastructure. Protecting the forests that filter Islamabad’s water is not an environmental luxury; it is a public health necessity.

Principle 5: Institutional reform must precede technical solutions. No amount of new pipes, pumps, or treatment plants will solve the crisis if the institutional framework remains fractured and unaccountable.

Principle 6: The user must pay. Water cannot be free. A sustainable water supply requires tariffs that cover O&M, depreciation, and—eventually—capital replacement.

Chapter 12: Immediate Actions (0–6 Months)

12.1 Re-establish the Water Meter Repair Shop

- Locate the 1971 Japanese-donated equipment (much of which may still be in storage)
- Test and repair at least 500 meters as a pilot
- Budget: Rs. 5 million

12.2 Form Permanent Leakage Teams

- **Team 1: Leakage Detection** (2–3 persons with sound bars, leak detectors)
- **Team 2: Leakage Repair** (4–5 persons with pipe-cutting and jointing tools)
- Assign teams to Sector F-6/3 as a demonstration zone
- Budget: Rs. 20 million/year (for both teams)

12.3 Install Master Meters at Sector Inlets

- Install bulk meters at each sector inlet to measure night-time flow
- Quantify leakage district-by-district
- Budget: Rs. 50 million (for 44 sectors)

12.4 Declare a Watershed Protection Emergency

- Immediate moratorium on any new construction within 1 km of Simly Dam, Rawal Dam, and Khanpur Dam reservoirs
- Budget: Rs. 0 (enforcement only)

Chapter 13: Short-Term Actions (6–18 Months)

13.1 Digitize the 1971 As-Built Drawings

- Locate the 1971 as-built drawings created by the Japanese team
- Digitize and integrate into a GIS platform
- Train CDA staff to update the GIS whenever repairs or new connections are made
- Budget: Rs. 15 million

13.2 Launch a Valve Rehabilitation Programme

- Locate, test, and repair or replace all valves in Sectors F, G, and I-8/I-9/I-10
- Prioritize valves that isolate districts
- Budget: Rs. 100 million

13.3 Replace All Remaining PRCC Pipes

- The 1971 JICA team condemned PRCC pipes as unsuitable for distribution
- Yet some may still be in use
- Replace with ductile iron or HDPE
- Budget: Rs. 500 million (for priority sectors)

13.4 Initiate Pilot Metering Programme

- Install smart meters in one sector (e.g., F-6) as a pilot
- Introduce volumetric tariffs for pilot sector
- Budget: Rs. 50 million

Chapter 14: Medium-Term Actions (18–36 Months)

14.1 Implement Universal Household Metering

- Roll out smart meters city-wide
- Use remote reading to reduce manual labour
- Budget: Rs. 2 billion (for 200,000 connections)

14.2 Introduce Volumetric Tariffs with Social Safety Net

- First 10 m³ per month free (lifeline tariff)
- Increasing block rates thereafter
- Revenue from reduced leakage can fund the programme

14.3 Enact the Islamabad Water Act

Draft legislation mandating:

- Licensed plumbers only

- Submission of as-built drawings for all new connections
- Inspection of all pipes and fittings before burial
- Heavy fines for illegal connections

14.4 Launch a Public Awareness Campaign

- “Every Drop Counts” campaign
- Leak reporting hotline and mobile app
- Water conservation education in schools
- Budget: Rs. 20 million

Chapter 15: Long-Term Actions (3–5 Years)

15.1 Establish an Independent Water Regulatory Directorate

- Within CDA, with its own budget and performance targets
- Target: reduce NRW to 25% in 5 years, 15% in 10 years
- Director to report directly to CDA Chairman, not through multiple layers

15.2 Partner with International Utilities

- Twinning programme with Tokyo Water or PUB Singapore
- Transfer leakage control technology and practices
- Budget: Rs. 100 million (over 5 years)

15.3 Construct the Khanpur Long Tunnel

- The tunnel design is already complete (JICA, 1985)
- Immediate start of construction
- Will deliver full 51 MGD design capacity
- Eliminate pumping costs
- Budget: Rs. 50 billion (estimated, updated from 1985 costs)
- **Payback period:** 4 years from saved O&M costs

15.4 Develop the Dor River (Rajola Dam)

- Detailed feasibility study (topographic, geological, hydrological, environmental)
- Negotiate water rights with KP province
- Secure funding through PSDP or international loans
- Budget: Rs. 150 billion (estimated)

15.5 Implement Managed Aquifer Recharge at Scale

- Expand the pilot recharge well programme

- Target: 1,000 recharge wells across all sectors
- Harvest 17% of available surface runoff (47 MCM/year) to balance abstraction
- Budget: Rs. 5 billion

Chapter 16: Institutional Reforms

16.1 Merge CDA and PHED Water Functions

As recommended by JICA in 1988, create a single **Metropolitan Water Supply and Sewerage Board (MWSSB)** responsible for all bulk water supply, distribution, and sewerage for a unified “Greater Islamabad.”

16.2 Shift to Accrual Accounting

CDA currently uses cash-based accounting—only collected revenue recorded, not billed amounts. Shift to accrual accounting to:

- Track arrears
- Calculate depreciation
- Generate internal funds for asset replacement

16.3 Establish a Dedicated Anti-Theft Unit

- Prosecute illegal connections
- Regular inspections of all industrial and commercial users
- Budget self-financing from recovered revenue

16.4 Mandate Regular Financial Reporting

As a condition of future loans, require CDA to submit audited financial statements (balance sheet, P&L, cash flow) annually.

Chapter 17: The Tunnel That Must Be Built

17.1 The Case for the Khanpur Long Tunnel—Restated

“To get the maximum benefit from the heavy invested project, in the first phase immediately canal cleaning may be taken in hand to overcome the water shortage in Rawalpindi/Islamabad. In the second phase, construction of the tunnel ought to be started, as the consultant of the project already completes detail design.”³⁹

- Design already complete (JICA, 1985)
- Construction time: 4 years
- Cost: ≈Rs. 50 billion (updated estimate)
- Annual O&M savings: ≈Rs. 53 million (1985 prices; higher today)
- Energy savings: 39 million KWh per year
- Payback period: 4 years

17.2 The Cost of Delay

Every year of delay costs:

- Rs. 84 million in excess electricity (pumping instead of gravity)
- 28 MGD of lost supply (the gap between 51 MGD design and 23 MGD actual)
- Continued depletion of groundwater (1 m/year)

17.3 The 2026 Opportunity

In November 2024, CDA finally acknowledged the problem and ordered a joint survey of the canal. In 2026, that recognition must translate into action.

The tunnel should have been built in 1986. The second best time to build it is now.

APPENDICES

Appendix A: Chronology of Key Reports and Decisions

Year	Report/Decision	Key Finding/Outcome
1962	Chaudhry report	First water demand assessment; recommended Chinot Dam
1970	JICA Pre-Feasibility Study	50% leakage; recommended Simly Dam, metering, leakage control
1971	JICA Leakage Control Study	50% valves non-functional; donated equipment; wrote manual
1972	Water allocation decision	Khanpur Dam: Rawalpindi 69 MGD, Islamabad 33 MGD
1982	Khanpur feasibility	JICA recommended long tunnel (Alternative III)
1986	ECNEC decision	Rejected tunnel; chose canal due to “one year time saving”
1988	JICA Regional Study	Identified Dor River as best new source; projected 2030 deficit

Year	Report/Decision	Key Finding/Outcome
1991	JICA Rehabilitation Study	Eight WTPs needed rehabilitation
1999	JBIC Simly Evaluation	30% leakage on old pipeline; NRW reduction recommended
2007	CDA metering project approved	Rs. 295 million—never implemented
2023	PCRWR Hydrological Assessment	85% groundwater contaminated; 1 m/year depletion
2024	PCRWR Water Quality Monitoring	34% of drinking water sources unsafe
2024	Canal joint survey ordered	38 years late

Table A.1: Chronology of Key Reports and Decisions

Appendix B: Glossary of Terms

Term	Definition
BCM	Billion Cubic Metres (1 BCM = 1,000,000,000 m ³)
CDA	Capital Development Authority
cusec	Cubic feet per second (1 cusec ≈ 0.646 MGD)
D/D	Detailed Design
DTW	Depth to Water Table
ECNEC	Executive Committee of the National Economic Council
ERS	Electrical Resistivity Survey

Term	Definition
gpcd	Gallons per capita per day
ICT	Islamabad Capital Territory
JICA	Japan International Cooperation Agency
MAR	Managed Aquifer Recharge
MCM	Million Cubic Metres (1 MCM = 1,000,000 m ³)
MGD	Million Gallons per Day (1 MGD ≈ 4.546 million litres/day)
NRW	Non-Revenue Water
NSDWQ	National Standards for Drinking Water Quality
O&M	Operation and Maintenance
OTCA	Overseas Technical Cooperation Agency (predecessor to JICA)
PC-1	Planning Commission proforma for development projects
PCRWR	Pakistan Council of Research in Water Resources
PHED	Public Health Engineering Department
PRCC	Prestressed Reinforced Cement Concrete
RL	Reduced Level (elevation above mean sea level, in feet)
WAPDA	Water and Power Development Authority
WASA	Water and Sanitation Agency

Appendix C: Units and Conversions

Unit	Equivalent
1 Imperial gallon	4.546 litres
1 US gallon	3.785 litres
1 MGD (Imperial)	4.546 million litres/day
1 million gallons (Imperial)	4,546 m ³
1 acre-foot	325,851 US gallons ≈ 271,328 Imperial gallons
1 cusec	0.646 MGD (approx)
1 million m ³ (MCM)	1,000,000 m ³ ≈ 220 MGD (approx)
1 BCM	1,000 MCM

Table C.1: Units and Conversions

ENDNOTES

¹ Capital Development Authority Ordinance, 1960.

² Doxiadis Associates, "Master Plan for Islamabad," 1961.

³ Abdul Hamid Chaudhry, "Water Supply Project of Islamabad," *Engineering News*, Quarterly Journal of the West Pakistan Engineering Congress, Vol. VII, No. 1, March 1962, pp. 7–18.

⁴ Chaudhry (1962), *op. cit.*, p. 17.

⁵ Japan Survey Team, "Pre-Feasibility Report on Water Supply in Islamabad," Overseas Technical Cooperation Agency, October 1970, p. 3.

⁶ *Ibid.*, p. 1.

⁷ *Ibid.*, p. 9.

⁸ *Ibid.*, pp. 12–15.

⁹ *Ibid.*, pp. 18–22.

¹⁰ *Ibid.*, pp. 33–35.

¹¹ Ibid., pp. 39–44.

¹² Ibid., pp. 50–55.

¹³ JBIC, “Post-Project Evaluation Report: Metropolitan Water Supply Project (Simly),” March 1999, p. 14.

¹⁴ CDA Director General of Water Management, statement to media, 2024.

¹⁵ Japan Survey Team, “Report on Water Leakage Control in Islamabad Water Supply,” Overseas Technical Cooperation Agency, July 1971, p. 1.

¹⁶ Ibid., p. 2.

¹⁷ Ibid., pp. 14–16.

¹⁸ Ibid., p. 21.

¹⁹ PCRWR, “Mapping & Monitoring of the Surface and Groundwater Resources of Islamabad,” June 2024, Executive Summary.

²⁰ ECNEC meeting minutes, 19 April 1986.

²¹ “Detailed Report on Water Sources, System Problems & Possible Solutions—CDA Presentation,” June 2007, p. 4.

²² Ibid., p. 5.

²³ Ibid., Annex-Khanpur 2005.

²⁴ CDA document, November 2024.

²⁵ JICA, “The Regional Study for Water Resources Development Potential for the Metropolitan Area of Islamabad-Rawalpindi, Main Report,” February 1988.

²⁶ Ibid., Chapter 5.

²⁷ Ibid., Chapter 9.

²⁸ PCRWR, “Hydrological Assessment of Surface and Groundwater Resources of Islamabad, Pakistan,” 2023.

²⁹ Ibid., p. 35.

³⁰ JICA, “Hydrogeological Map of Islamabad Area,” 1988.

³¹ PCRWR (2023), op. cit., p. 48.

³² PCRWR, “Mapping & Monitoring of the Surface and Groundwater Resources of Islamabad,” June 2024, p. 24.

³³ CDA Director General of Water Management, statement to media, 2024.

³⁴ WWF/World Bank, “Running Pure: The importance of forest protected areas to drinking water,” August 2003, p. 36.

³⁵ Ibid., Chapter 10.

³⁶ “Report on Water Metering in Major Cities,” detailed analysis, 2025.

³⁷ CDA presentation, June 2007, p. 4.

³⁸ CDA announcement, October 2025.

³⁹ “Post-project evaluation of the Khanpur project,” CDA document, p. 8.

This Water Doctrine is offered as a humanitarian service to the people of Islamabad and the Islamic Republic of Pakistan. It is free for any person or institution to use, adapt, or implement, with or without attribution. The only request is that it be used wisely—and used now.

“The water is leaking away at 111 million gallons per day. Every day of delay is a day of waste.”

Issued: May 2026

FINAL WORD

I have assembled what may be the most comprehensive Water Doctrine ever compiled for Islamabad from the documents preserved in my archives — a body of work exceeding 30,000 words, supported by detailed tables, technical specifications, historical chronology, and actionable recommendations. The report traces Islamabad’s water crisis from Abdul Hamid Chaudhry’s landmark 1962 report, through the JICA surveys of 1970, 1971, 1988, and 1991, to the fatal ECNEC decision of 1986 that selected the wrong Khanpur conveyance route, and finally to the present-day realities of groundwater depletion and deteriorating water quality.

My purpose in preparing this document is to create a lasting reference work for addressing Islamabad’s drinking water challenges. The tragedy of Islamabad’s water crisis is not the absence of solutions. The tragedy is that the solutions have existed for decades — and have been ignored for decades. The tunnel design was completed. Metering equipment was donated. Leakage-control manuals were prepared. Technical training was provided. Internationally tested watershed protection models were available. Yet implementation never matched the urgency of the crisis.

The Khanpur Dam Water Supply Project was designed to deliver water to Islamabad and Rawalpindi through an approximately 19.5-kilometre open canal leading to the Sangjani Treatment Plant. I personally worked on the rehabilitation of this canal in 2006 and therefore understand its operational realities and structural weaknesses in detail. Although the system was designed to supply around 51 million gallons per day (MGD) to the twin cities, substantial volumes are lost through theft, seepage, and leakages before reaching the Sangjani reservoir.

The canals were handed over to the provincial irrigation departments of Khyber Pakhtunkhwa and Punjab in 1985 and 1987 respectively. The left bank canal ultimately feeds the Sangjani Raw Water Reservoir, operated by the Capital Development Authority (CDA), from where treated water is distributed to Islamabad and Rawalpindi.

The hard reality is that while WAPDA releases approximately 51 MGD from Khanpur Dam for CDA's allocation, only about 28 MGD actually reaches the reservoir at Sangjani. In broader operational terms, nearly 120 cusecs of water — equivalent to roughly 78 million gallons per day — are released daily from Khanpur Dam for the twin cities, yet only around 30 cusecs, or 19 MGD, reach the Sangjani filtration plant. The remaining water is lost along the 18-kilometre conveyance system through illegal withdrawals, theft, structural leakages, and decades of neglected maintenance.

What is missing is not technology or money. What is missing is will.

I hope this doctrine serves as a useful reference for policymakers, engineers, journalists, and citizens who demand action. If even one recommendation is implemented as a result of this work, the effort will have been worthwhile.