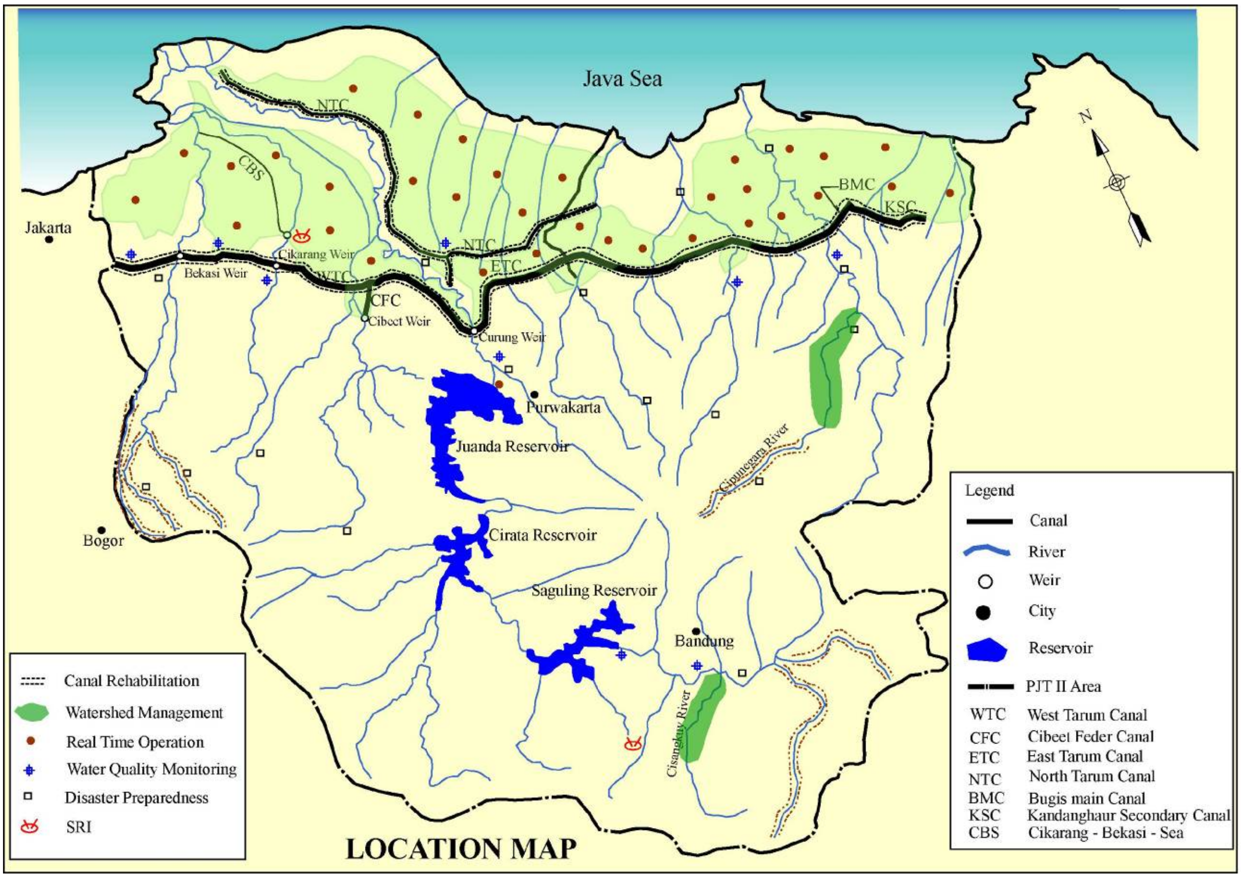
4 Program Area Description

4.1 Extent

Although the proposed roadmap focuses on the Citarum River Basin, the "basin" area defined for the purposes of the proposed program includes the Citarum River hydrologic basin, as well as a number of smaller river basins to the east and west that are hydraulically, if not hydrologically, linked to the Citarum River. The program area is shown in Figure 3. The basin is entirely in West Java Province.

Figure 3: Program Area



4.2 Topography and River Network

The Citarum River is the largest river in western Java, the region which contains Jakarta, the capital of Indonesia. The river originates in the mountain range near the southern coast of Java that includes many high volcanic peaks including Mount Wayang (elevation 2,200m), and travels in a generally north-westerly direction for about 270km until it empties into the Java Sea east of Jakarta. Its drainage area is about 6,600km^2. The upstream reaches of the river run in mountainous to gently undulating hilly lands for about 200km, while the lower 70km stretch drains a vast flat alluvial plain.

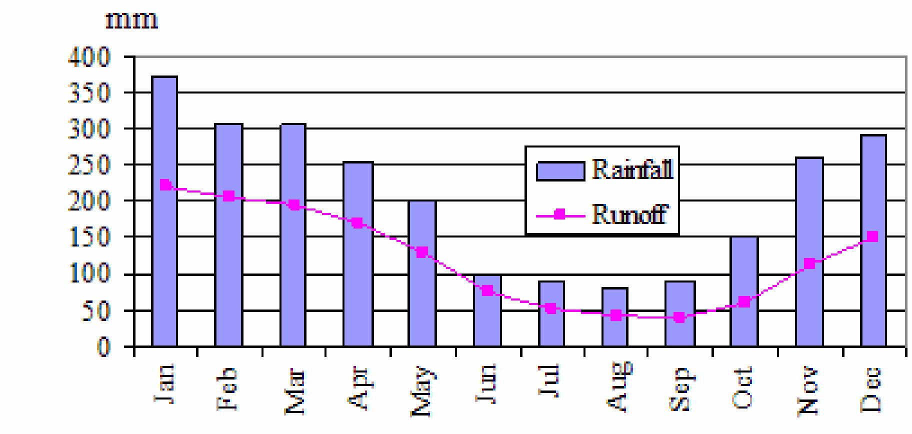
4.3 Water Resources

The climate of the program area is characterised by two distinct seasons: rainy season and dry season. The rainy season occurs during the months of November to April, while the dry season occurs during the remaining months. January is the wettest month, while August is the driest month. Naturally, runoff follows the same seasonal pattern.

The average annual rainfall varies from 1500 mm in the coastal areas to 4000 mm in the mountainous areas in the upper part of the basin. There are 24 river gauging stations within the basin. This total runoff from the catchments is generally considered to be adequate to supply demands for all uses well into the future. However, the spatial distribution of surface water resources is not uniform, and shortages do occur from time to time in certain areas.

Monthly distribution of rainfall and runoff in the program area are illustrated and shown in Figure 4.

Figure 4: Average Seasonal Rainfall and Runoff



Groundwater occurs extensively across the river basin, but is most intensively exploited in the Bandung area. The total number of bores there is estimated to be well in excess of 5,000, with depth between 60 m and 200 m below ground level. Groundwater is the preferred source for domestic water supply in rural and many urban areas and also for industrial purposes due to the easy accessibility, relative inexpensive treatment and generally of good quality. Over-exploitation of groundwater resources has become a serious issue around Bandung (see Section 5.5).

4.4 Administrative Areas

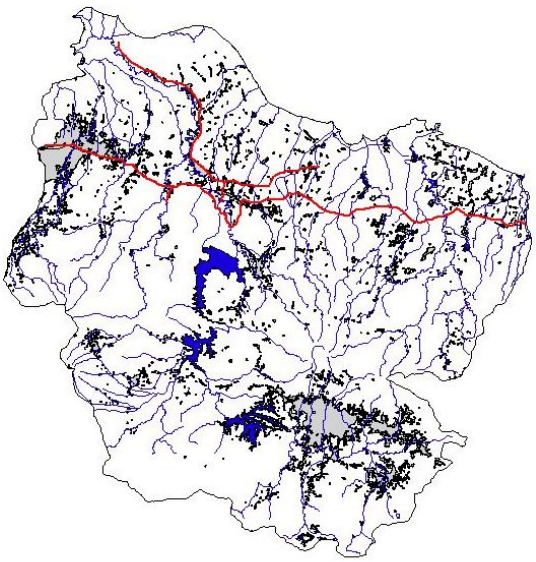
The entire program area is covered by the territory of West Java Province. Within the program area there are a total of fourteen districts, although three of these cover a quite insignificant area. The district boundaries are shown in Figure 5.

Figure 5: District Boundaries Within the Program Area

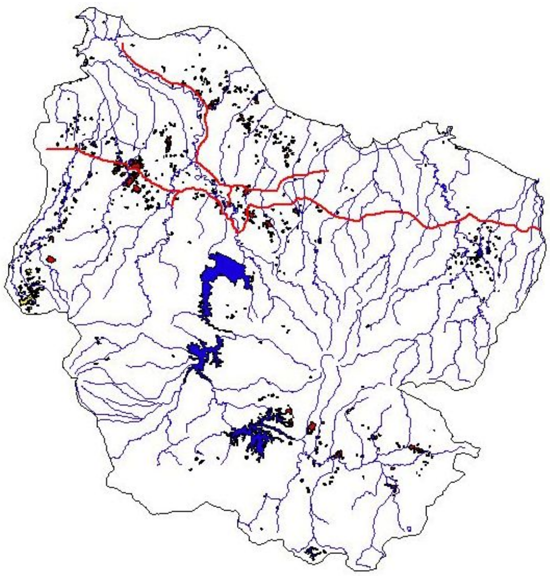
4.5 Settlements and Industry

The program area covers 9 districts and 2 cities. Of the 9 districts, 5 lie wholly within the program area. Figure 6 shows the administrative boundaries. The population in 2003 was 17.8 million, with 4.1 million households – 30% derived livelihood from agriculture, 25% from industry, and 45% from services. The population in the program area is projected to rise to 21.3 million by 2010. The dynamism of the region's economy is shown by 2003 data indicating West Java Province's gross regional domestic product (GRDP) growth rate (4.97%) outperforming that of Jakarta (4.39%).

Figure 6: Land Use



Settlements



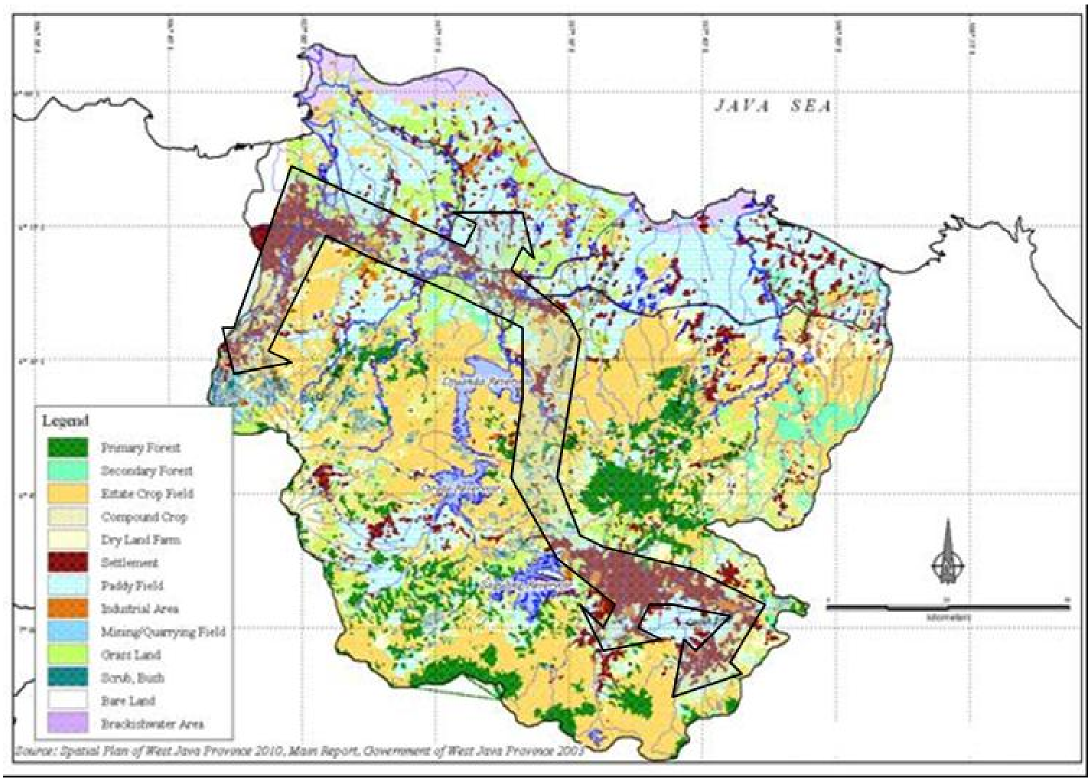
Industrial Establishments

The Bekasi and Bandung regions are the most heavily populated and urbanised. Bekasi essentially acts as a satellite city of Jakarta, absorbing most of the industrial and population expansion to the east. The catchment of the Bekasi River is rapidly transforming into numerous housing subdivisions and industrial estates – with development pressure coming from both the north (Jakarta) and south (Bogor). Paddy fields to the north of Bekasi are also being converted to residential and industrial uses.

The Bekasi area in particular has been experiencing rapid population growth and urbanisation. A 2000 census shows that 22% of Bekasi City residents and 18.5% of Bekasi District residents are migrants that have moved into the area only within the last five years of the census.

Industrial locations are generally interwoven with settlements and there is no clear zoning or separation of these land uses in the region. Although settlements and industry make up only 8.2% of the program area, their impact on land use change in the region is significant. The mixed industry-settlement land uses are clustered along a rapidly urbanising corridor defined by the recently completed expressway linking Jakarta and Bandung, which passes through Bekasi, Karawang and Purwakarta. The arrowheads in the urban corridor depicted in Figure 7 show the direction of urban sprawl stimulated by the new highway corridor. In the coming years, urbanization will take place both in the form of continued expansion toward the upper catchments (in Bekasi and Bandung) and via a more recent but accelerating expansion toward the coast in Karawang.

Figure 7: Rapidly Developing Urban and Transport Corridor



Bekasi City and Bekasi District, for example, are projected to grow in terms of population by 20% in 2010, compared with Year 2005 figures (around 2 million each). Karawang's population, too, is projected to grow from 1.97 million in 2005 to 2.15 million in 2010 (9% growth). Between 2000 and 2005, Karawang's population grew by 11%. In the Upper Citarum region settlement areas increased from 25,000 ha in 1992 to 46,000 ha in 2001. This corresponded with a 40% decline in paddy field areas, from 12,500 ha in 1992 to 75,000 ha in 2001. As in Bekasi, the upper basin is experiencing a rapid conversion of paddy fields into settlements.

The pattern of urbanisation in the region has a significant impact on the water supply system, not only because of the projected increased demand, but also because much of the domestic and industrial water supply to Bekasi and Jakarta passes through the same corridor (West Tarum Canal). Settlements and commercial establishments are gradually encroaching on the canal easements, threatening both water quality and water supply security.

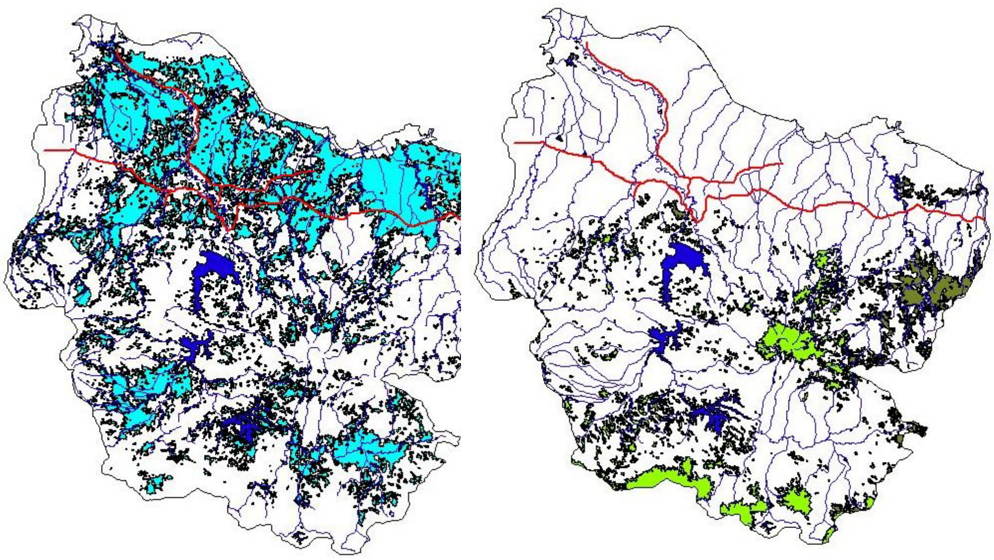
4.6 Agriculture and Forestry

The area is a key rice producer for the country. There are a total of 390,000 ha of irrigated paddy fields, with 240,000 ha served by the Jatiluhur reservoir and canal system in the lower basin. Land devoted to rice production make up nearly half (47.5%) of the program area, with 70% of these fully irrigated. Rain-fed areas cover 43,000 ha, or about 10% of the land use. See Figure 8.

In the Upper Citarum watershed around Bandung District, hilly land farming is pervasive and many of the farmers still prefer to plant vegetables and annual crops that do not provide adequate cover and protection from soil erosion. The population density in Bandung District is 32 persons per ha, growing at 3.45% annually. By the year 2010, the population in the district is projected to reach 7.4 million. Forty percent of the population is engaged in agriculture. In the Upper Citarum as a whole, land used for upland farming increased from 6,000 ha in 1992 to 37,000 ha in 2001.

In the Upper Citarum, the expansion of urban settlements is taking place largely through conversion of the surrounding paddy fields. On the other hand, the expansion of the upland farming areas (which increased by 31,000 ha from 1992 to 2001) is taking place at the expense of the forest. Thus, forested areas in the Upper Citarum has declined from 35,000 ha in 1992 to 19,000 ha in 2001 (45% reduction).

Figure 8: Agriculture and Forest Map



Rice Producing Areas Primary and Secondary Forest Areas

The remaining forests cover only about 10.2% of the program area—100,600 ha of primary forest, and 34,800 of secondary forest—far less than the 30% mandated in the Forestry Law (#41, 1999). While nearly all of the remaining primary forests are designated for protection and conservation, secondary forests are still considered as production forests where harvesting of forest products and timber is allowed. Much of the remaining primary forest is in fragmented condition, reducing their viability as an ecosystem and making them vulnerable to continuing encroachment and conversion for upland farming. Creating corridors to link these fragmented forests is important for ensuring their ability to support biodiversity.

5 Re-Assessment of Basin Issues

5.1 Introduction

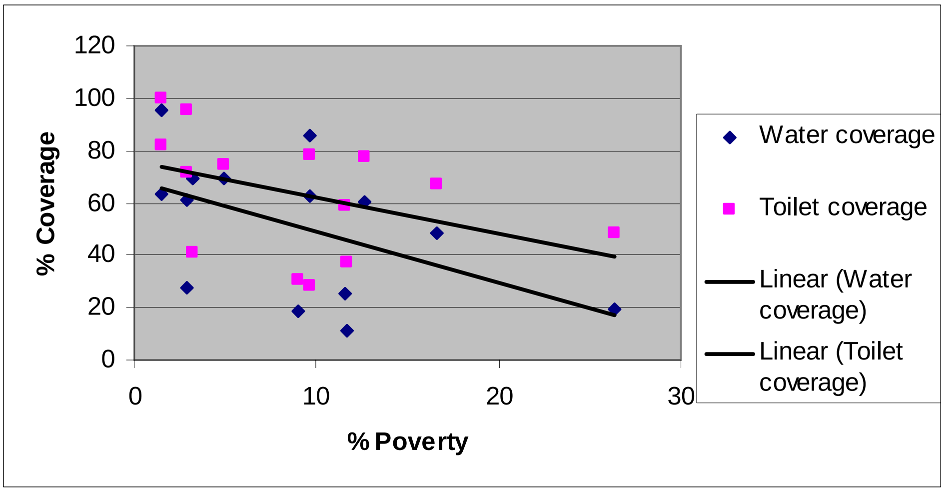
During Phase 3, work was undertaken to re-assess the basin issues to confirm the answer to the “Where are we now?” question. This assessment is not at odds with the assessment made in Phase 1 of the PPTA, but perhaps presents a strategic view.

5.2 Poverty

The situation regarding poverty and access to water supply and health facilities in the 15 districts and municipalities that lie fully or partially in the Citarum river basin, based on SUSENAS 2004 data, can be summarised as follows:

- A poverty headcount of 2.8 million or 9.7% of the basin population with poverty levels of the total populations ranging from 1.5% to 4.8% in the municipalities (which are totally urban) and 2.9% to 26.4% in the districts (which have a mix of urban and rural populations). In some districts poverty is more prevalent in the urban population compared to the rural population, in other districts it is the reverse—there is no clear pattern.
- Access to clean water in the municipalities varies 77-97% of total population (poor and non-poor), whereas in the districts it is lower and lies in the range 37-87%; coverage is significantly lower amongst the poor in all areas except Bekasi and Cianjur where levels between poor and non-poor are similar.
- Coverage of households with toilets in the municipalities varies 94-100% of total population, whereas in the districts it is 53-89%; in many areas coverage is significantly lower amongst the poor, but in others (Bekasi, Depok, Cianjur and Subang) coverage is similar between poor and non-poor.
- The comparison between poverty and coverage of households with clean water and household with toilets shows that there is a general trend between low poverty and high coverage of water and toilet facilities, and higher poverty and lower coverage of facilities (see Figure 9).

Figure 9: **River Basin Poverty and Coverage of Households with Clean Water and Toilets**



5.3 Institutional Arrangements

Indonesia's 2004 Water Law provides the enabling framework for IWRM. Implementation of IWRM within a river basin context is being promoted through establishment of river basin management units or *Balai / Balai Besar.* In view of its strategic importance to the country, a combined basin comprising the Citarum, Cisadane-Ciliwung, and Cidurian-Ciujung-Cidanau rivers has been designated as one planning unit under the policy guidance of a single Basin Council. It will be managed initially through three sub-basin *Balai Besar*. The *Dewan Air* or Basin Council will represent national, provincial, district and other stakeholders, incorporating a balance between government and non-government representatives.

Recently, a range of water management responsibilities (such as water quality management) have been delegated by GOI to the *kabupaten* (district government bodies), in a move to devolve decision-making closer to the "grass roots". While this is an admirable aim, it has its problems, for instance: the number of *kabupaten* is large and their technical capacity to discharge their responsibilities effectively is very limited in many cases; (ii) "fragmentation" of decision-making can lead to inconsistencies in water policies from one area to the next; and a high degree of coordination is required at higher levels.

Despite attempts to improve the institutional framework for river basin and water resource management, there appears to be general agreement that (i) current institutional arrangements are highly sectoral with limited effective coordination and (ii) although regulatory frameworks and standards are generally in place (e.g. for water quality or licensing), enforcement is weak. Consideration of the organizational functions inherent in integrated water resources management demonstrates that:

- Responsibilities of the Directorate General of Water Resources of the Ministry of Public Works (DGWR), Provincial Water Resources Service (PWRS), Jasa Tirta Public Corporation II (PJT II), West Java Irrigation Project and the Citarum River Water Resources Irrigation Project are limited to in-stream activities (related mainly to surface water irrigation, flood and drought management, and so on) and have little influence in off-stream aspects that have been identified as some of the key problems facing the basin (deterioration of the watershed, pollution control, waste disposal, groundwater exploitation, and so on);

- The current focus of the provincial and basin coordination mechanisms also tends to concentrate on these in-stream areas; and
- Groundwater is the responsibility of provincial and district agencies responsible for mineral resources – not water resources.

5.4 Surface Water Management

Average annual demand from the Jatiluhur Reservoir has increased from 140 m^3/sec in 1996 to 156 m^3/sec in 2004. In 1996, the Jatiluhur system supplied adequate water releases for irrigation and domestic/industrial supply (through the West, North and East Tarum Canals). However, in 2001, the system reportedly failed to meet water needs for 1.5 months during the dry season; and in 2005, it failed to meet water needs for 5 months.

Inflow into Saguling Reservoir has been decreasing. Between 1986 and 1991, dry season flow into the Saguling reservoir was 38% of the average annual flow. This percentage went down to 36% between 1992 and 1997, and declined further to 34% starting in 1998. Watershed degradation is seen as the principal cause. Denuded catchments have reduced capacity to capture rainwater, resulting in high peak flows during the rainy months. In turn, the lower water retention capacity reduces the amount of water available for release as “base flow” during the summer months.

It is not certain to what extent water scarcity at the source (catchment areas and reservoir storage) is the real problem. The common view is that, catchment runoff and reservoir storage volumes are adequate, but the poor condition of the water distribution system results in a lot of water being lost or wasted, thereby failing to meet water needs at the users’ end. This is particularly true for the lower basin area. The evidence is that hydraulic control structures in the lower basin are defective or are malfunctioning due to lack of maintenance. Nonetheless, continued watershed degradation combined with increasing water demands for agriculture, industry and drinking water are bound to create water scarcity problems in the coming years.

5.5 Groundwater Management

A considerable portion of the region’s water demand, in particular that of Jakarta and Bandung, is supplied by groundwater. The rate of groundwater extraction is believed to be considerably under-estimated, since a large portion of the extraction activities are not registered. Actual abstraction is believed to be at least three times the quantity reflected in official records.

As early as 1997, a study by the Japan International Cooperation Agency (JICA) had estimated groundwater abstraction in the Jakarta metropolitan area to be around 8 m^3/sec. This is about half of the surface water supplied to the metropolitan area by the West Tarum Canal (WTC). As reported in the JICA study, domestic use accounted for almost 90% of total groundwater abstraction in Jakarta. As a result, groundwater is thought to have exceeded sustainable levels. In both Jakarta and Bandung, over-exploitation of groundwater is reported to have caused land subsidence. In turn, this has caused structural damage to some buildings and, more significantly, exacerbated local drainage and flooding problems.

In Bandung, an estimated 90% of the population, and 98% of the industries, rely on groundwater. Modelling studies done in 2002 suggest that recorded groundwater extraction is only about one-third of the actual amount. The lowering of the groundwater level is reportedly up to 5 meters per year in some places. The cumulative water level decline since 1920 has been 85 m. In 2005, it was estimated that land subsidence had reached 0.8 m. In order to get clean water, industrial wells have to be drilled to beyond 150 m.

Industrial groundwater abstraction in Bandung has also had a devastating effect on shallow wells on which numerous households depend. Most industrial and domestic effluents—particularly for industrial establishments that are not covered by the PROKASIH (clean rivers) program--are not properly treated, and the infiltration of polluted water has caused deterioration in the water quality of shallow wells, indicated by black and yellowish water colour.

5.6 Erosion and Sedimentation

Watershed erosion is a serious problem in the upper river basin where hillsides are steep and the catchment denuded. Even on steep slopes, farmers cultivate non-perennial crops which do not provide adequate ground cover from the heavy monsoon rains. The soils, derived from volcanic tuff, are easily erodible and are prone to land slides. High peak flows have also increased the rate of river bank erosion.

Hydrologic flow regimes have been adversely changed by land degradation, notably the loss of adequate forest cover and the prevalence of hillside farming in the upper catchments. The degraded catchments have reduced capacity to capture rainwater, resulting in high peak flows during the rainy months which carry large amounts of eroded soil. At the entrance to Saguling Reservoir, the ratio of wet season high flows to dry season low flows has increased from 3.4 recorded in 1992 to 7.4 in 2003. As a result, landslides and mud flows are frequent during the rainy season. Figure 10 shows the extent of degraded areas in the basin (around 25% of the basin area). These areas have erosion rates in excess of 60 tonnes per ha per year.

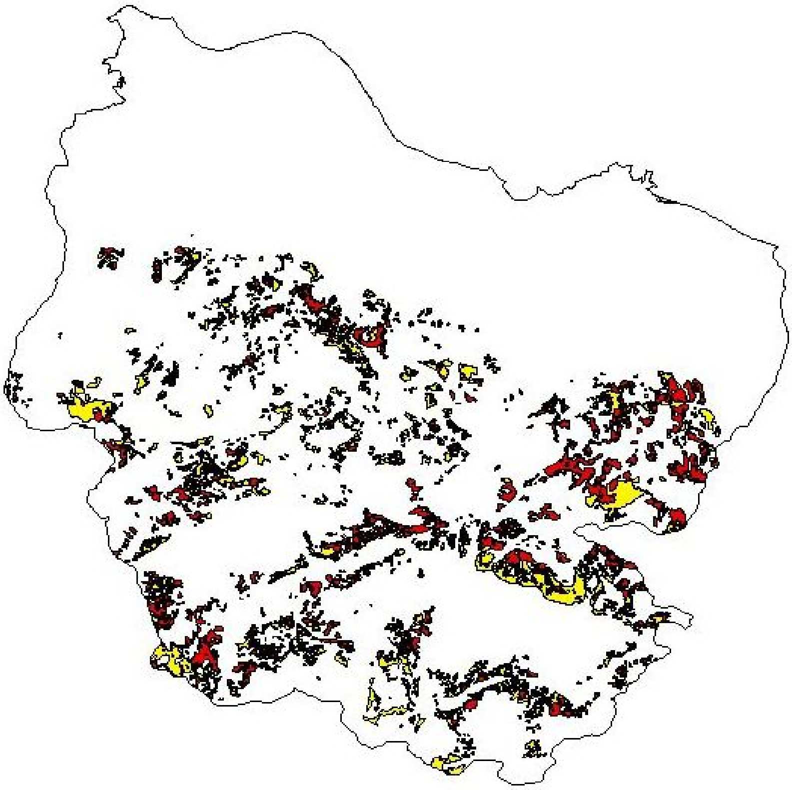
Wet season floods carry large amounts of sediment into the three reservoirs, especially at Saguling. Here, the average annual sediment inflow was estimated at 8 million m^3 (based on bathymetric surveys of the reservoir conducted in 2004 by Indonesia Power, a state-owned company). Relative to the Saguling reservoir's catchment area, the sediment load is equivalent to an erosion rate of 3 mm per year, nearly times the original design rate. A similar alarming rate of watershed erosion is reported for the Cirata reservoir.

The three cascading reservoirs (Saguling, Cirata and Jatiluhur) were built to regulate flows, provide hydropower, and store/supply water for irrigation, industrial and domestic use. They also trap sediments. However, the rate at which sediments are being deposited in the reservoirs is rapidly reducing storage capacity and shortening their useful life.

In the lower Citarum basin, regulated discharges coming from the Jatiluhur reservoir combine with the flow from the Cikao River. The latter transports considerable quantities of sediment into the Curug diversion weir. Although much of the sediment is prevented from entering the canals (WTC, NTC and ETC), the large quantities of sediment are transported downstream by the Citarum River. The Cibeet River, which joins the Citarum River, adds a significant volume to the latter's sediment load. This load is then deposited in the delta where it silts up the river outlet and exacerbates flooding.

Within the WTC, sediment is brought into the canal at the confluence with the Cibeet, Cikarang and Bekasi Rivers. Occurring mainly during the rainy season, the sediment load has silted up the canal bed and caused reduction in canal conveyance capacity. Whereas the source of sediment load in the upper basin is watershed denudation due to upland farming, the sediment load from the Cibeet and Bekasi Rivers come from land conversion to support urban development activities taking place in the catchment.

Figure 10: Extent of Degraded/Eroded Areas



5.7 Flooding

Flooding is a consequence mainly of changes in the river flow regime, in turn caused by changes in watershed conditions. As water retention capacity of the river catchments is reduced by denudation and land conversion for urban development, flood peaks have increased. As mentioned above, the ratio of wet season peak flows to dry season low flows in the upper basin has increased from 3.4 in 1992 to 7.3 in 2003. The increased flood frequency and severity are also invariably associated with destructive landslides and mud flows. In the upper basin (Bandung area), recent severe flooding and mud flows occurred in February 2005 affected an area covering 2,000 ha. The flooding submerged parts of the area for 7 days and up to 2 meters deep – 50,000 inhabitants had to be evacuated.

Flooding around Bandung has become more frequent and severe. Here, however, there is no single cause. The problem is due to a combination of: (i) watershed denudation, (ii) effects of past re-alignment/straightening of the Citarum River (through cut-offs) which, while alleviating flooding upstream, increase peak flows downstream, (iii) localized land subsidence due to groundwater over-pumping that impair drainage, and (iv) clogging of drainage canals and streams by garbage. Flood-prone areas around Bandung are located in the south area of the city along the Citarum River.

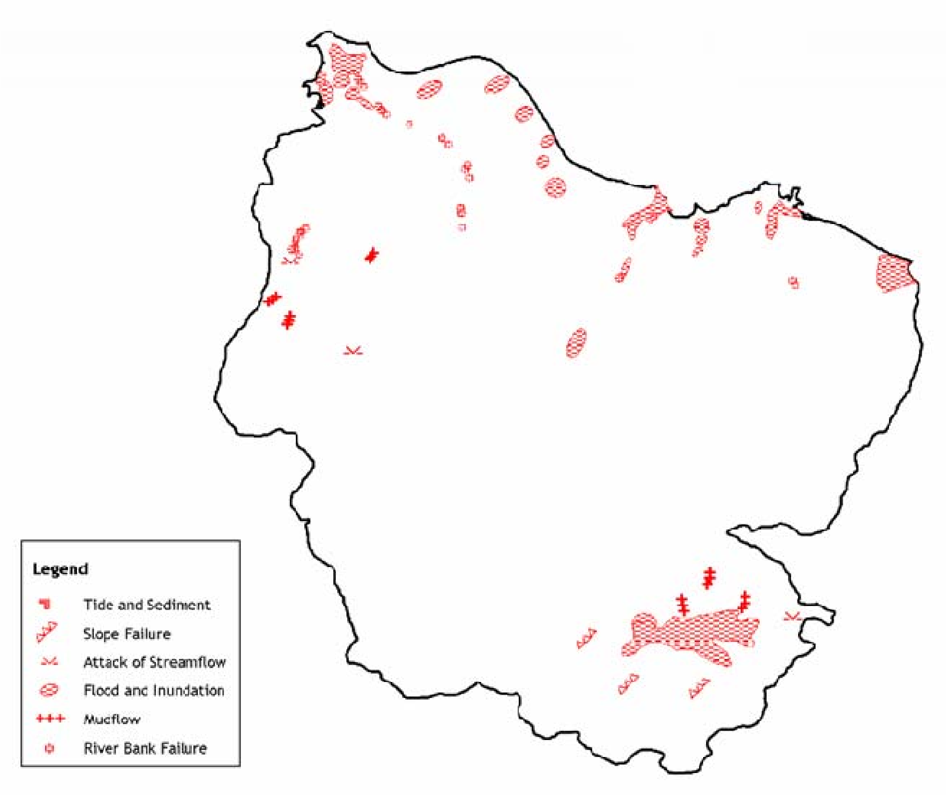
Currently, measures to reduce or mitigate flooding problems in the upper basin are being undertaken through the Upper Citarum Flood Control Project. Remediation measures include re-greening/reforestation and introduction of structural erosion control measures in the watershed, as well as improvement of the urban drainage system around Bandung.

At the lower basin (near Jakarta) where the Cikeas and Cileungsi Rivers join to become the Bekasi River, converging floodwaters from the two tributaries have caused perennial flooding in Bekasi City. Already naturally prone to flooding due to the area's location downstream of the confluence of two rivers, the flooding problem is expected to worsen as more of Bekasi's upper catchment is subjected to land conversion for urban and industrial development.

Along the lower Citarum River levees and other flood control works built during the Dutch period help confine flooding within the river's meander zone and provide protection to the surrounding settlements. However, large areas of the flood zone within the levees have been planted with crops and fruit trees that have the effect of retarding flood flow, contributing to high water levels. In addition, a long term effect of the river embankments has been to raise the river bed due to sediment accumulation, since the levees prevent the spilling of sediments onto the surrounding plain. Consequently, floodwater levels inside the levees have risen above the level of the surrounding land, putting the population at risk in case of levee failure.

At the Citarum River mouth, the build-up of deposited sediments has created sand dunes that impede floodwater discharge. Combined with the effect of high tides, the constricted river outlet causes perennial inundation of the lower basin near the delta as the water is forced to back up into the alluvial plain. The extent of areas affected by flooding and related landslides and mudflows is shown in Figure 11.

Figure 11: Flooding and Related Problems in the Basin



5.8 Water Pollution

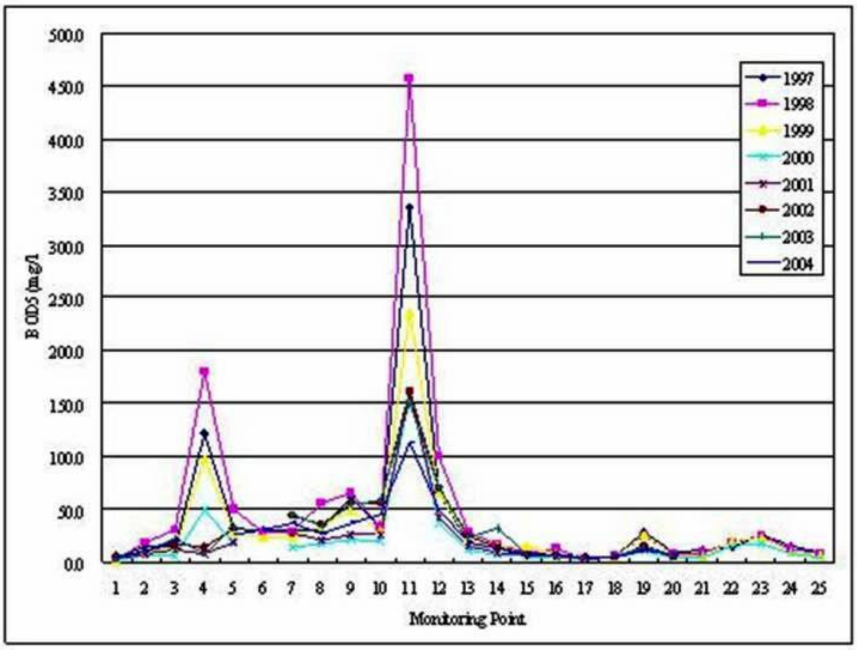
The population within the program area is growing at more than 3% annually, attributed in part to influx of migrants drawn in by the region's rapid pace of development. The combined effects of untreated domestic sewage, solid waste disposal and industrial effluents have significantly increased pollution loads in the Citarum River system. In the upper basin, river water that is polluted by domestic and industrial wastes from the Bandung metropolitan area is funnelled into the Saguling reservoir. At the inlet to the reservoir, water quality monitoring in the late 1990s showed average annual BOD concentrations as high as 300 mg/l. Control measures taken reduced the BOD load to 200 mg/l by year 2000, and further reduced to 55 mg/l during subsequent years. However, as reported by *Indonesia Power* in 2004, BOD concentrations at the Saguling reservoir inlet have still gone up to as high as 130 mg/l during the dry season. In recent years, the BOD concentrations in the Cikapunding River (a major tributary of the Saguling River that flows through Bandung) were still reported to reach as high as 100 mg/l. Figure 13 gives a profile of the BOD levels in the Citarum River.

Figure 12: Pollution in the Citarum River at Bandung

Runoff from farmed hillside areas, in addition, bring in massive amounts of plant nutrients (nitrogen and phosphorus) that induce eutrophication in the reservoirs. At Saguling where the problem is most significant, nitrogen loading has been estimated at 33,350 tonnes per year, and for phosphorus, 4,370 tonnes per year. Algal blooms and their subsequent decay have been blamed for the regular occurrence of fish kills and considerable damage to the floating fish cage industry (although some fish kills have been attributed to other causes, for example, viruses and bacteria). In turn, the uncontrolled expansion of fish cage operations is exacerbating the effects of polluted water coming into the reservoir. Improper or excessive fish feeding in the floating cages adds to the waste load as unconsumed feed accumulates on the reservoir bed. When these organic deposits are disturbed and resuspended (for example, at the start of the rainy season when increased inflows induce mixing in the reservoir) oxygen demand becomes excessive. This is thought to be a key factor in causing perennial fish kills.

Figure 13: BOD Profile of the Citarum River

Point No.	Monitoring Point
1	Wangisagara
2	Majalaya
3	Citarik Sapan
4	Ciganitri
5	Sapan
6	Cikapundung Dayeuh Kolot
7	Cisangkuy Dayeuh Kolot
8	Margahayu
9	Cibeureum Brujul
10	Nanjung
11	Cimahi Nanjung
12	Batujajar
13	Saguling Inlet
14	Saguling Outlet
15	Cirata Inlet
16	Cirata Outlet
17	Jatiluhur Inlet
18	Jatiluhur Outlet
19	Cikao
20	Curug Weir
21	Bendung Walahar
22	Tanjung Pura
23	Tunggak Jati
24	Rengasdengklok
25	Muara Gembong



Whereas pollution of the (upper basin) Saguling reservoir poses a serious threat to the viability of fishery activities and potential future use of the reservoir to supply water to Bandung, the pollution in the lower basin – particularly in the downstream portion of the West Tarum Canal – poses an even more urgent water quality problem. The WTC supplies 80% of Jakarta's (surface) raw water supply, and hence is vital to the well-being of 8 million inhabitants. On its route to Jakarta, the WTC intersects the Bekasi River which drains an area rapidly being developed for residential and industrial use. At the Bekasi River's confluence with the WTC, the average annual BOD concentration in 2004 was 48 mg/l (measured at the weir site). The pollution load in the Bekasi River is caused by untreated household sewage, industrial wastewater, and solid waste dumped along the river banks.

Figure 14: Solid Waste Dumping – West Tarum Canal

Lack of proper solid waste management contributes to both pollution and flooding. Garbage deposited along canals and riverbanks contribute to the high BOD. They also clog drains and accumulate on riverbeds reducing discharge capacity. According to the *PD Kebersihan* of Bandung City, average daily solid waste generation is 6,500 m^3/day, of which an estimated 1,500 m^3/day is not collected and properly disposed. Thus the annual uncollected garbage that invariably ends up accumulating in the drainage system and rivers amounts to 500,000 m^3. According to the Saguling Dam office, the estimate inflow of solid waste into the reservoir is 250,000 m^3 per year.

Along the West Tarum Canal, reduction in conveyance capacity is due both to sediment deposits and the prolific growth of aquatic plants (which create friction in water flow). Apart from contributing to the bottom detritus, aquatic plants trap silt and accelerate canal shallowing. Plant growth is promoted by the use of the canal as toilet and bathing/washing area for residents, which adds substantial quantities of plant nutrients in the water.

Residential and commercial establishments along the canal are dense particularly downstream of the waterway from Cikarang and Bekasi to Jakarta. There is open access to the canal (only the Jakarta portion is fenced). Where the canal width has narrowed and more land has been exposed on the water side of the road embankment, food stalls, scavenging shops, and other small-scale commercial establishments have sprouted. Wastewater and garbage from these establishments are disposed of directly into the canal.

5.9 Watershed Condition and Biodiversity

One of the primary tools in watershed management and restoration of watershed ecological function is reforestation or re-greening of degraded lands. There have been seven attempts to 're-green' parts of the Basin since 1976. All these, including the recent Citarik Upland Plantation and Land Development Project, have failed in this regard. It is widely considered these failures are because projects have not sufficiently educated villagers about the importance of their role in such activities, have not empowered villagers and have tried to accomplish reforestation in short time frames. In summary, watershed management as it relates to conservation of biodiversity, either directly or through improved habitat (land, water and forest) management, ultimately depends in large part on engaging a large number of villages in conservation efforts. Some feel that poverty is the root cause of villagers disinterest in improving their stewardship of the environment. Others consider it is because the population explosion and subsequent urbanization and peri-urbanization have fragmented village structures and organizations. This fragmentation has resulted in loss of village 'unity' and subsequent lack of empowerment. This lack, coupled with inadequate land tenure arrangements and access to land, offers villagers no incentive to protect land.

Figure 15: Deforestation of Steep Hillsides in the Upper Citarum

Implementation of watershed management activities as they relate to biodiversity conservation will largely take place at the level of groups of villages. As such the umbrella management body to assist village activities (empowerment, assistance with support funds, mentoring, monitoring & evaluation) that is needed is at the scale of a sub watershed. The challenge is to link such sub-watershed management bodies to proposed Citarum River Basin umbrella management authorities (*Dewan* and *Balai Besar*).

Villager activities in the upper watersheds are a major threat to both the quantity and quality of water available to down-stream users. Management of natural resources important to biodiversity needs to include a system of reward 'payments for environmental services' (PES) to encourage upland villagers mitigate activities that are inimical to water, forests and protected area services. In return, their communities would receive benefits for their surrendering traditional uses of these natural resources.

The greatest threat to biodiversity in the twelve protected areas in the basin comes from villagers that live in their proximity. Key management scenarios need to focus on involvement of villagers in management planning and implementation. While some protected areas, such as Gunung Gede Pangrango National Park, have a strategic management plan, there is a general absence of functionable action plans to drive focused management and little knowledge of their biodiversity. Further, for protected areas, there are: (i) insufficient human resources and capacity to effectively manage them; (ii) insufficient awareness among communities and provincial government of benefits, costs, and responsibilities of management; absence of significant sustainable economic incentives for communities, local government or the private sector to support management of their surrounding watershed; and (iii) lack of stakeholder involvement in their management.

5.10 West Tarum Canal

West Tarum Canal is seen as a very high priority by GOI for inclusion in the MFF. However, while in an engineering sense, the rehabilitation of the canal is relatively straightforward, significant social and environmental issues must be addressed.

The rehabilitation of WTC will require physical works and will involve dis-placement of people from homes and lands, albeit without certificate, including the acquisition of other assets, such as structures and trees. It is, however, believed that the rehabilitation of WTC (and other existing water conveyance systems, such as the East and North Tarum Canals, if these were to be rehabilitated in future), will not require widening of the present surface width of the canal and the works will likely be confined within the established and acquired right-of-way (ROW) of the waterway and its ancillary facilities. Therefore, acquisition of private land[3] may not be required in the rehabilitation of WTC.

System improvement of WTC will mainly require dredging and removal of silt, and the rehabilitation of ancillary structures (i.e. flumes that double as canal crossing for people, sluice gates, etc). However, a number of fixed structures, such as houses and shops, are found along the inner slope of the canal embankments; they will have to be removed. Additionally, wooden and bamboo platforms used for toilet, bath and for laundry abound on the water surface of the canal. These too have to be removed.

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[3] Here private land refers to land that is covered by formal legal rights (*hak milik*), and customary and traditional rights (*adat* or *ulayat*).

Figure 16: Informal Settlements along West Tarum Canal

With regard to the dredging and removal of silt, an estimated 1.4 million m^3 of silt and earth will be removed from WTC. Disposal of these dredged materials is, however, a potential resettlement issue. Project authorities will, and has actually done so in the past, stockpile re-usable dredged earth on the embankments of WTC as a temporary staging area. Said re-usable earth will be used in fortifying or fixing segments of the embankments needing repair. On the other hand, un-suitable dredged materials, such as silt, will be dumped in former river beds that came to be as a result of the re-channelling of the river following the construction of the Curug Weir, the Cibeet Weir, and the Cikarang Weir. Over the years, local residents have developed these ex-river beds into productive farmlands using dredged materials dumped thereat from previous maintenance activities for raising and levelling the ground. The dumping of 1.4 million m^3 particularly in the ex-river beds will deprive farmers a cropping season, at the minimum.

The following resettlement issues have been identified and will have to be addressed based on the Compensation Policy Framework and Procedural Guidelines (CPFPG) developed with the assistance of the PPTA to be adopted by the Government and concurred with by ADB: (i) use of the shoulder of the inspection road for the temporary stock-piling of re-usable dredged materials; (ii) loss of use of areas of the ex-river beds which residents have made productive over the years with the planned dumping of spoils thereat; (iii) acquisition of a number of structures on the embankments and which are concentrated at bridges and road crossings, including platforms on stilts above the water and which are used for toilet, bath, and laundry; and (iv) possible disruption, if not total cutting-off, of the water supply of individual households that tap water directly from the canals with the use of rubber hoses.

There are associated social issues that need to be addressed in the system improvement of WTC. These issues revolve around health and sanitation in the locality and these are rooted to poverty. While for instance owners of toilet and washing facilities in WTC will be compensated at replacement cost for these structures, these affected persons (APs) and their communities also need to be provided with alternative facilities that are hygienic and that will last. The APs cannot be allowed to rebuild their temporary toilet facilities in the waterway following completion of civil works in WTC; it is not just the health of these APs that is at risk but also those of water users in Jakarta. Another health issue that requires a sustainable alternative with the clearing of WTC of obstructions concerns the need to provide communities adjacent to the embankments with safe household water. Water hoses connected to individual houses abound in the entire stretch of the canal. The third health-related issue concerns the risk of sexually-transmitted diseases (for example, HIV/AIDS) spreading during rehabilitation works on WTC since sections of the inspection road at Bekasi have many karaoke bars.

The aforementioned are called *associated* social issues because, while they are not brought about directly by the project, these health and sanitation concerns will worsen and might actually be exacerbated during the execution of the rehabilitation works.

5.11 Water Quantity and Quality Monitoring

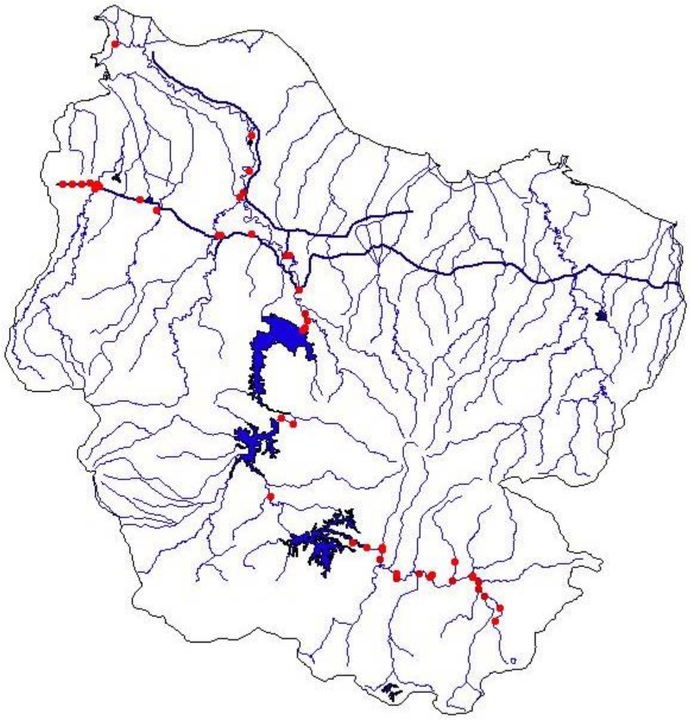
There are more than 160 rainfall gauging stations within the program area. Some of the stations have been in operation since the Dutch period. Several agencies are in charge of monitoring rainfall. The mean annual rainfall in the region varies from 2000 to 5000 mm. The upstream areas of the Ciherang and Cilamaya Rivers, including the watershed of the Ciputnegara River, receive the heaviest annual rainfall exceeding 4,000 mm. The coastal alluvial plains received the lowest rainfall.

Twenty four river gauging stations monitor flows of the Citarum River and adjoining rivers. Daily flow data for these stations are available for the period 1994 to 2004. The most recent flow data for the Citarum River are reported in the *Pola Operasi Citarum*, dated 2005, issued by the Coordination Committee for Water Management of Citarum River.

Surface water provides only for part of the basin's water needs. A considerable portion of the region's water demand, in particular that of Jakarta and Bandung, is supplied by groundwater. The rate of groundwater extraction is believed to be considerably under-estimated, since a large portion of the extraction activities are not registered nor monitored. Actual abstraction is believed to be at least three times the quantity reflected in official records.

Under the PROKASIH (clean rivers) program there are supposed to be 75 water quality monitoring stations along the Citarum River and its main tributaries. Only a fraction of these stations are currently being monitored by PJT II, which maintains a laboratory at Curug (manned by 15 staff). Due to budgetary constraints, PJT II's monthly monitoring is currently limited to 25 points along the Citarum River, and 11 along the WTC. Additional stations are being monitored by the Bandung-based *Puslitbang Pengairan* which monitors 10 stations, BPLDH-West Java province (7 stations), and a number of district government units through their role in the PROKASIH program. It is unclear which institution is consolidating results from the various monitoring activities. The location of the water quality sampling stations of PJTII and *Puslitbang Pengairan* is shown in Figure 17.

Figure 17: Location of Water Quality Monitoring Stations



PJT II operates an accredited laboratory and industries routinely send effluent water samples to the its lab for analysis of specific parameters, which is paid for by industries. There are reportedly 105 such requests received every month, on average. The PJT II laboratory fees are half the cost charged by private laboratories. On the other hand, the subsidized fees of the lab may be a factor that discourages more private water quality laboratories from offering services.

A sediment survey of WTC was carried out in late 2005 during Phase I of the PPTA. Ten samples were taken along the canal. Although positive values observed for copper, nickel, chromium and mercury (heavy metals), these were found to be below Japanese Environmental Quality Standards (EQS) for soil analysis to detect contamination. However, the average value for lead was found to exceed the Japanese standard. Other heavy metals (cadmium and arsenic) have not been detected in the canal sediments. It is suspected that the lead found in the sediments originated from atmospheric fallout due to pervasive use of leaded fuel over the past several decades (the phase out of leaded fuel in Indonesia was completed in 2005). A 1998 study reported that lead contamination found in Jakarta soil samples ranged from 77 to 223 ppm.

5.12 Issues Analysis

In order to better understand the issues and their relationships, the “problem tree” analysis approach was used. Actually, this same approach had been used in Phase 1, but as a result of the re-assessment of basin issues, it was updated, and the result is shown in Figure 18.

Figure 18: Problem Tree