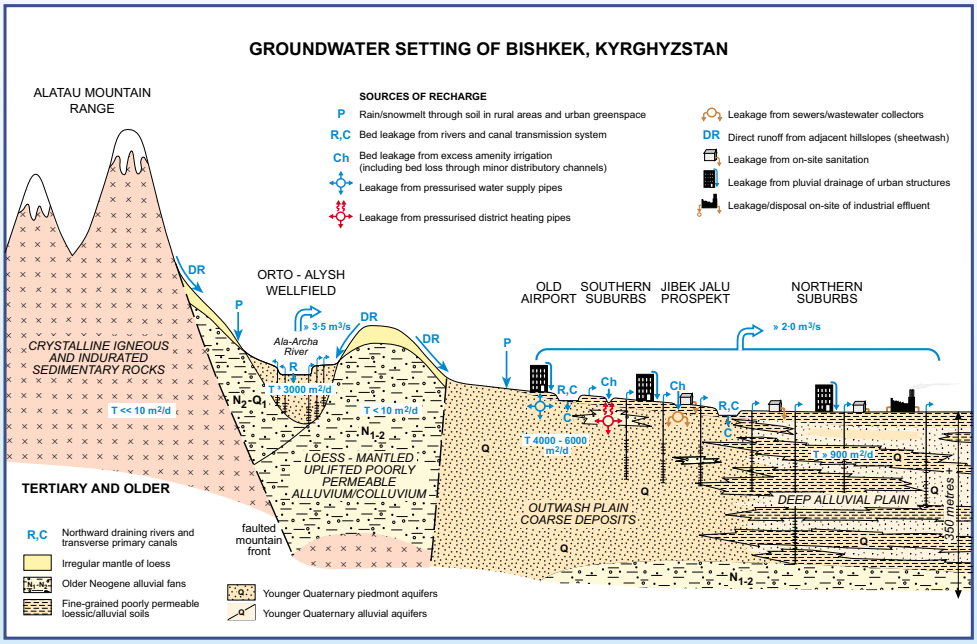
URBAN GROUNDWATER PROFILE



Example from Bishkek

Task checklist for completion of Urban Groundwater Profile for Bishkek, Kyrghyzstan

	Activity	Completed?
1.	Translate the generic outline, if necessary	✔
2.	Obtain completed Questionnaire and accompanying material (maps; reports; diagrams; etc)	✔
3.	Identify additional data sources	✔ (None found)
4.	Select the individual or team that will prepare the Profile	✔(B L Morris)
5.	Contact the data sources and inform them of the purpose of the Profile and rapid groundwater assessment	✖ (Not considered necessary in this instance)
6.	Monitor the work of the Profile preparation team to identify and solve problems	✔(Some data gaps could not be filled and this inhibited comprehensive profile
7.	Review first draft of profile to locate information gaps, errors and inconsistencies	✔
8.	Ensure missing data are collected and analysed, if possible, and have errors and inconsistencies corrected	✖ Further data collection work not possible within available project resources after data collation stage
9.	Circulate draft of Profile to data providers to ensure that information is accurate and up to date	✖ (Not considered necessary in this instance)
10.	Print and mark the Profile available to interested parties (see Section 5 on stakeholder analysis)	✔ (Available as project record; with hindsight this would have been a useful early newsletter item in both cities).

URBAN GROUNDWATER PROFILE FOR BISHKEK, KYRGHYZSTAN

1. Socio-economic context

Physical setting: Bishkek is the capital city of the Kyrghyz Republic, a former republic of the USSR and an independent state since 1991. The city lies on the outermost northern flanks of the foothills of the Alatau range of the Tien Shan mountains at an elevation of 725-900 m above sea level.

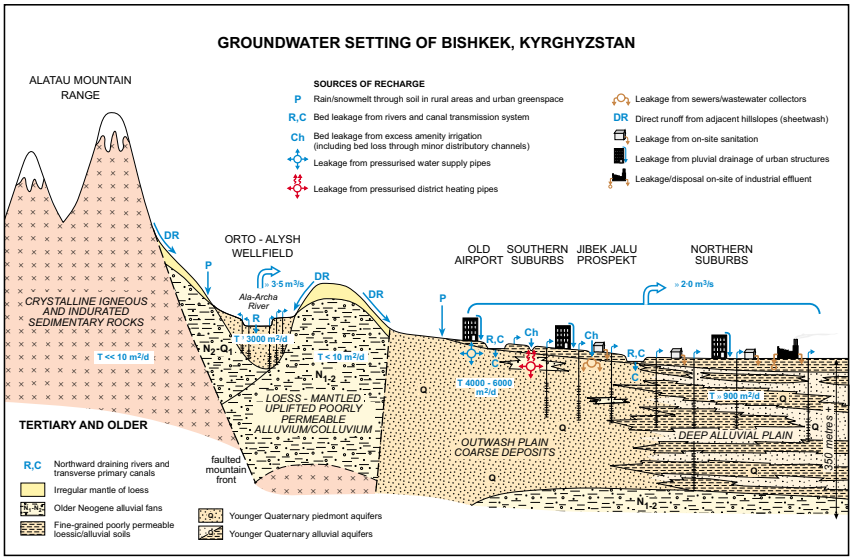
Demographics: The population of Bishkek is approximately 600,000 with a mean population density in the city area of 37.5 persons/ha and a high reported annual growth rate of 2.72 %/y in the mid-1990s.

Economic structure: It is the country's industrial centre and has witnessed changes since independence, notably the decline of the once-dominant Soviet military-industrial sector, and the increase in small private businesses, often with foreign investment. Manufacturing, transport, commerce/retailing and government are the principal activities. Per capita GNP was US$550 in 1996 and over 50% of the city population was below the urban poverty line of US$504.

Municipal water services: The majority of abstraction boreholes are operated by the municipal water supply agency, and provide water for both domestic and industrial processes. The wastewater disposal system comprises a widespread piped sewerage element, to which industrial, commercial, apartment and public buildings together with some low-rise residential housing are connected, and a dispersed on-site sanitation element in many low-rise residential areas.

2. Groundwater degradation risk assessment

Hydrogeological setting:

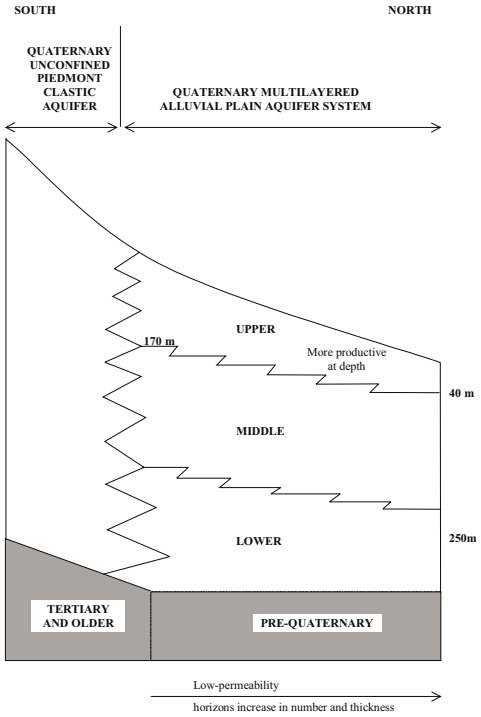


The groundwater setting is shown above and key features include:

- A semi-arid climate but extensive opportunities for recharge from rivers draining the nearby Alatau range of the Tien Shan Mountains.
- A complex unconsolidated fluvioglacial/alluvial aquifer system of Quaternary age which is in excess of 350 m thick in northern districts of the city.
- Strong lateral and vertical variability. As a first approximation the system fines laterally northwards away from coarse clastic piedmont deposits composed of coalesced alluvial fans fronting the foothills into more stratified deep alluvial plain sediments.
- Unconsolidated sediments provide intergranular flow conditions, and there is hydraulic connection with surface flow in snow-melt rivers and associated canal systems, especially across the southern piedmont area where the aquifer system is considered to be both unconfined and to possess strong vertical connectivity.
- More complex semi-confined conditions are present in the northern part of the city where 3 aquifer systems have been identified by other resource investigation projects (see sketch below). Scope for significant pumping-induced vertical leakage exists, especially in the southern parts of Bishkek

Profile cont'd;

where low permeability horizons in the alluvial tract are thinner and less numerous.



Extent of aquifer development: Features of the urban water infrastructure imposed upon this hydrogeological system include:

- 100% dependence on groundwater for drinking water, industrial and heating water needs.
- A very extensive piped water infrastructure (pressurised hot water as well as drinking water mains, plus piped sewerage), widespread use of on-site sanitation in single/two-storey residential areas and significant amenity irrigation of communal parts of residential areas.
- Supply wells located in a highly productive but very localised periurban valley-fill wellfield (Orto-Alysh production wellfield) and also throughout the urban area, at various depths.
- Urban wells screened extensively in middle aquifer (typically >120 m intake depth), but the lower part of the upper aquifer (40 m-120 m) also widely tapped.

Contaminant load: No published studies were located during the information search

Groundwater management & institutional arrangements: The urban water supply and sewerage utility Vodokanal is a semi-autonomous part of the municipality. Industrial supply wells are either operated by Vodokanal on behalf of the enterprise, or are privately run, as in the case of the major wellfields supplying water for district heating to the energy sector. At the time of the project, there were still very few functioning private domestic wells or other municipal/community boreholes Regulatory agency powers are widely considered to be much less than under the former soviet system, in part due to underfunding of state agencies and in part to ensure there are few obstacles to investment in a country desperate to attract foreign capital, especially from Turkey. The utility is regarded as under funded, with ageing infrastructure and low investment levels. Domestic water supply is generally on a fixed charge tariff, irrespective of usage and significant debts are carried on behalf of large state customers such as the energy utility. With the current depressed state of the economy there is little prospect of debt recovery or of raising the present (non-economic) tariffs to the levels at which significant new capital investment can be made.

Summary assessment of groundwater pollution risk: This was undertaken as a project activity at a later stage. Vulnerability mapping and a potentially contaminating activities survey provided a 'hot-spot' map which informed the policy development stage conducted in consultation with stakeholders. .

3. Groundwater Degradation Impact Assessment

Although of undoubted benefit to both cities, an impact assessment could not be undertaken within the resources or timespan available to the project teams.