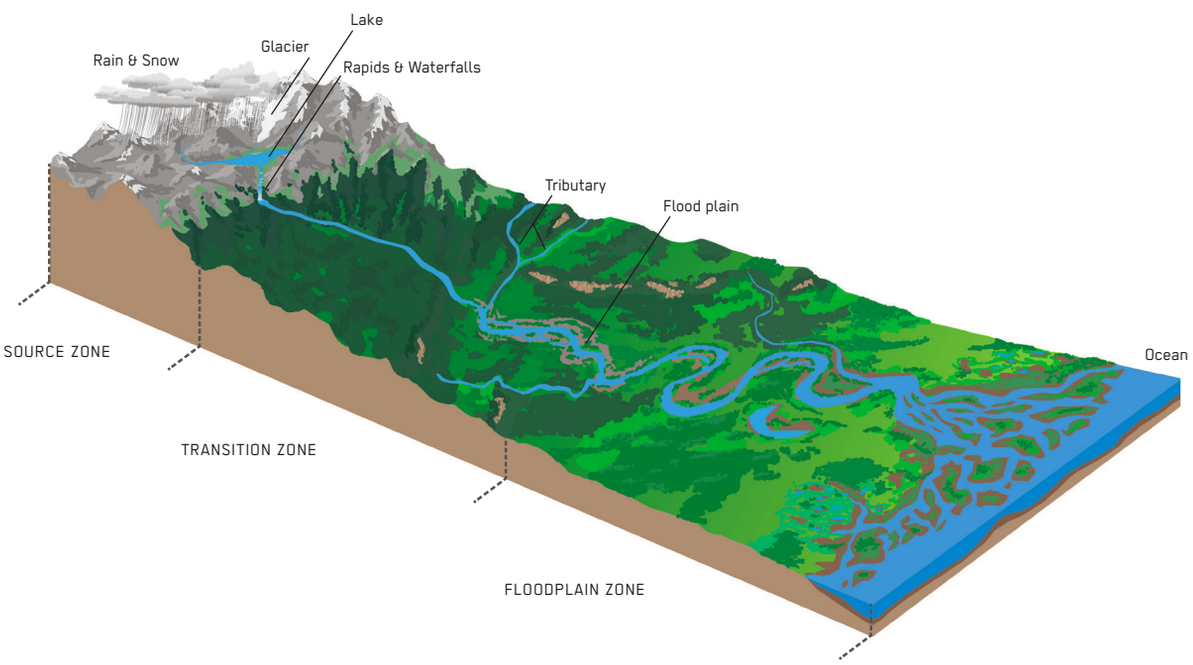
Rivers and Streams



A River or Stream is a naturally flowing, usually fresh, watercourse that moves towards an ocean, sea, lake or another River, though a River can flow into the ground and dry out at the end of its course without reaching another body of water. Rivers generally collect water from precipitation through a catchment basin from surface runoff and other sources, such as groundwater recharge, springs and the release of water stored in natural ice and snowpacks (e.g. from glaciers). They follow drainage channels that tend to be smaller and faster nearer the source and can be seasonal depending on the climate. Rivers are useful in acute stages of an emergency where large quantities of water are needed quickly, though they can be used in any phase.

The upstream section of a River near the source tends to be narrower and shallower, with faster flowing water often carrying a gravelly bed load. Further downstream, Rivers widen and deepen and the water velocity slows down, reducing the gravelly bed load, yet at the same time organic load and anthropogenic pollution is likely to increase. Many Rivers and Streams gain water from and/or lose water to groundwater during along their course, as the surface water in the River regularly interacts with groundwater in shallow aquifers, which causes variations in the total volume of River water. The main suitability issues for Rivers and Streams used as a water supply relate to water quantity and the seasonality of flow, as well as water quality and River velocity.

To ensure the River can meet the demand without causing major environmental or social disruptions, the total quantity of water available at any given time as well as existing water demands (e.g. of downstream wetlands or settlements) must be considered. When available, existing Stream flow data may be used when estimating water volumes; otherwise, an estimation of the water flow is needed. Rivers may be seasonal, with high flows in wet seasons that dry up completely in dry seasons when the flow is confined to the underground sedimentary material. For such Rivers, it may prove more productive to directly

exploit this groundwater, which will be both a more reliable source and will provide higher-quality water due to the filtering effect of the subsurface strata **(see I.5, I.6)**.
Water quality may be an issue with River sources, which depends largely on any contaminants entering the River from the upstream catchment. This contamination may be physical, microbiological or chemical. During the wet/high-flow season, both the silt load (turbidity) and microbiological contamination will generally be higher, particularly at the start. During the dry season, the silt load will reduce, but the total dissolved solids will increase. Some form of water treatment will therefore always be needed for surface water, which may be further complicated by industrial effluent or agricultural runoff entering the River. In addition to the danger of water-borne diseases caused by consuming poorly treated water from Rivers and Streams, other diseases can be spread through these sources. In slow-moving water (below 0.3 m/s), water-based diseases such as schistosomiasis may be an issue, as can other water-related diseases such as malaria or onchocerciasis.
An extensive overview of potential chemical and microbial hazards in surface water catchments is available from the WHO. In many cases, there are steps that can be taken to improve the quality of water withdrawn from Rivers to minimise treatment requirements. These include abstracting higher-quality water from near or underneath the riverbed after it has travelled through the subsurface zone, e.g. using infiltration galleries and collector wells **(see I.6)**, jetted wells **(see I.8)** and riverbed wells **(see I.7)**, minimising turbidity by choosing a floating intake **(see I.3)** or constructing the intake upstream of any obvious contamination sources. Rivers with large variations in seasonal flow can affect intakes due to an unstable riverbed, water-level variability and the speed of water flow **(see I.3)**. Seasonal flooding occurs in many River systems when surface runoff increases following rains, though flooding can also occur because of failures in man-made infrastructures (e.g. weir, dyke or levee).

Applicability: In the acute response phase, Rivers and Streams can often provide large volumes of water quickly through extractive pumping and bulk treatment in combination with water trucking (depending on the location of the users). They can also be useful in the stabilisation and recovery phases where large volumes of water are needed. The overall amount of water available depends on the stream flow in the River, its seasonality and the needs of other downstream users. In general, surface water taken from the upper reaches of a system will be safer to extract as it will be less contaminated and its use will have less effect on others. For smaller volume requirements, groundwater may serve as a more sustainable water supply (less treatment and equipment needed). Certain types of dams/embankments in seasonal Rivers (gully plugs, leaky dams) can be used to manage aquifer recharge of local groundwater for longer-term drought-mitigation projects.

Operation and Maintenance: The tributaries and catchment of a River can be managed in the longer term with a view to slow down and infiltrate runoff to minimise the flood risk and improve groundwater recharge. Measures related to this can include contour trenches, gully plugs, check dams and leaky dams, which slow down and infiltrate runoff, as well as a variety of farming techniques used to slow down water for crops (such as bunds, pitting systems, terraces, trash lines and planting vetiver grass along contours). O & M also involves establishing and respecting the limits of what can be considered safe withdrawal from the River to protect the needs of other users and to establish and maintain protection zones around the point of extraction.

Health and Safety: Microbiological water quality can generally be assumed to be poor in open water sources, and treatment will always be required. Runoff from urban or agricultural areas can also introduce problematic chemicals (e.g. pesticides). If these contaminants pose significant problems to treatment processes or public health, alternative sources of drinking water should be considered. Surface water may also have other associated health concerns, such as vector-borne diseases and schistosomiasis. Access to reliable water quality data, especially in the initial phase of a response, is often minimal. Sanitary surveys and historical data may be available from national bodies.

Social and Environmental Considerations: Generally, Rivers and Streams can be acceptable drinking water sources following appropriate treatment. However, if water is used for a certain purpose in one location, it might affect users in another downstream location, causing conflicts or affecting the broader ecosystem. When proportionally large volumes of water are planned to be withdrawn from a River, integrated water resource management principles including consultation with key stakeholders should be applied locally.

Strengths and Weaknesses:

⊕ Often easily available and accessible
⊕ Can facilitate recharge for local groundwater

⊖ Often has low water quality, which will require treatment
⊖ Can pose health risks from water-related diseases
⊖ Can be seasonal and prone to flooding
⊖ Structures can be damaged in unstable riverbeds

→ **References and further reading material for this technology can be found on page 212**