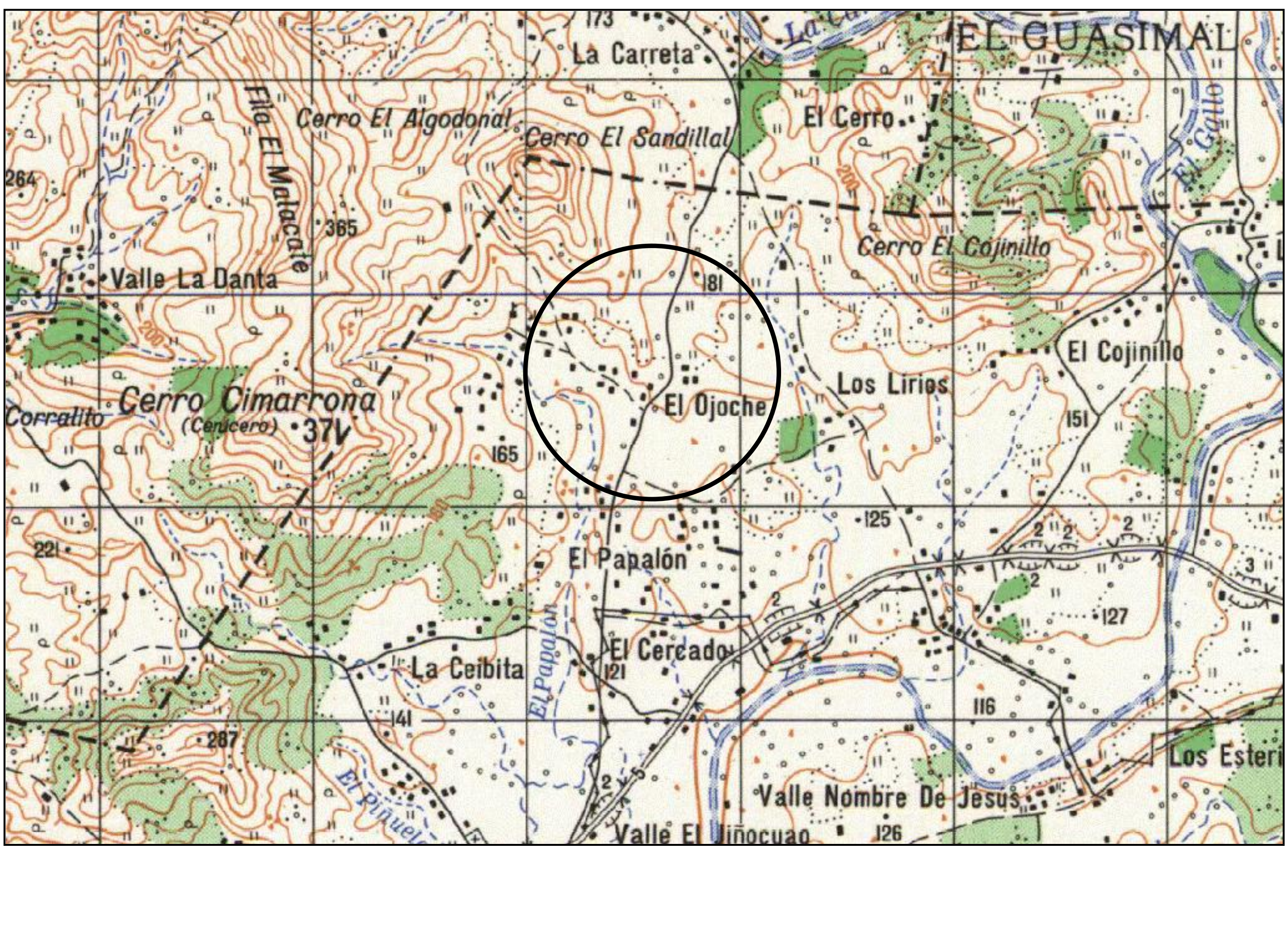
Visit to El Ojoche and recommendations for potential water projects

Background

The community of El Ojoche has been supported by a number of NGOs including the Nehemiah Centre and Food for the Hungry. Nuevas Esperanzas was asked to assist with an assessment of the feasibility of undertaking a project to improve access to water during the dry season by Mike Saeli of Food for the Hungry. This need was regarded as a priority in order to facilitate the development of family gardens and to improve access to water for household use in the most difficult months of the year.

Location and setting

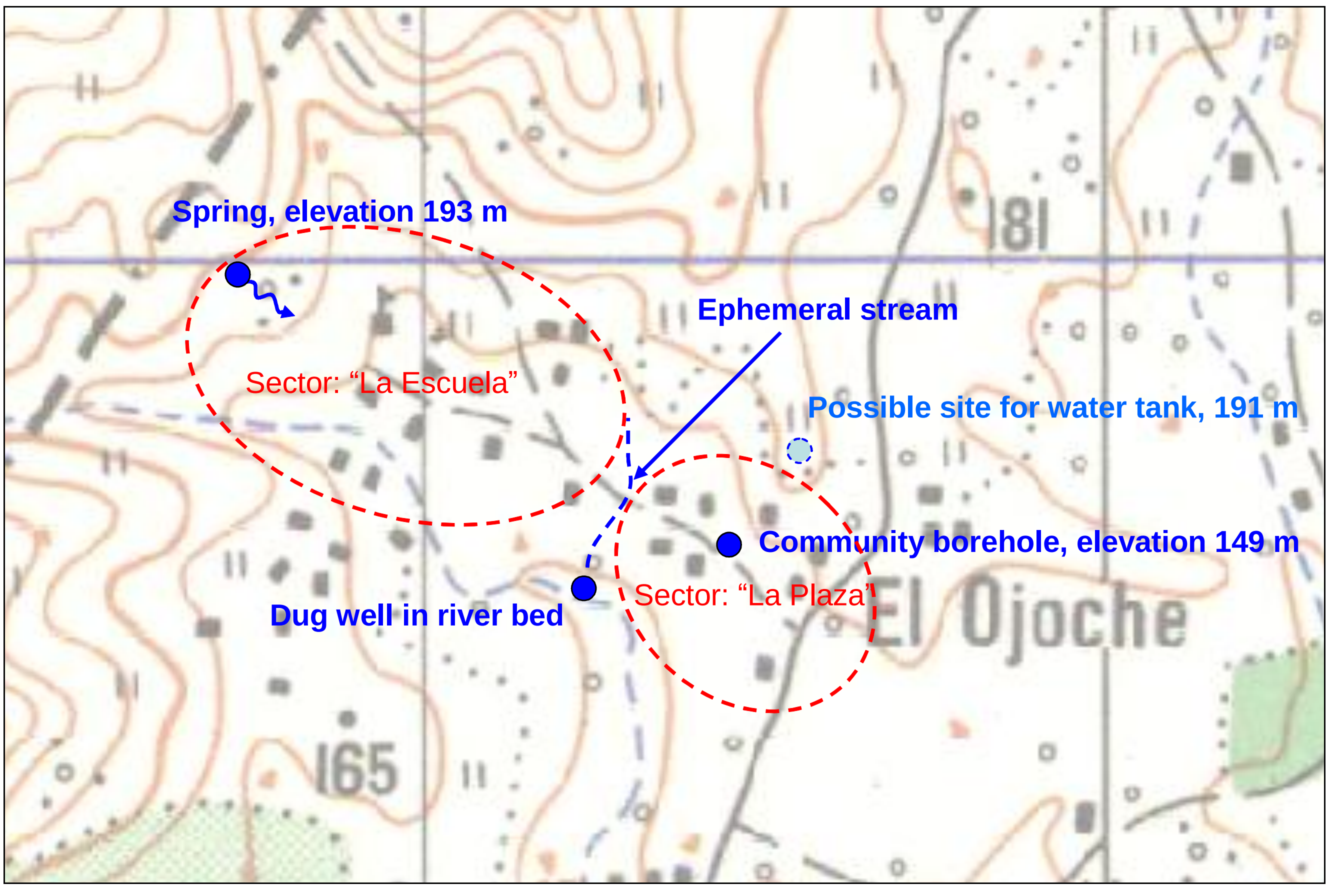
El Ojoche is located 14 km north-east of Somotillo in the Department of Chinandega, 9 km east of the Nicaraguan-Honduran border. It is situated at the foot of hills which rise towards the Honduran border, west of the community, and is approximately 1.5 km from the Río El Gallo, a tributary of the Río Negro (Watershed #58). The annual average rainfall is approximately 1400 mm (based on isohyets for 1971-1990). The area is situation at an intersection of three geological units. The Oligocene-Miocene Matagalpa Formation outcrops to the north and the overlying Miocene Inferior Coyol Group outcrops to the south; both units generally dip towards the south. To the east, the site is underlain by a Miocene granite/granodiorite intrusive complex. The rock types of the Matagalpa Formation and Inferior Coyol Group include basaltic, andesitic and rhyolitic lavas and volcaniclastics.



Site visit

Nuevas Esperanzas' staff visited the community on the 15th November, meeting with community leaders and visiting all parts of the community. The population of the community is around 400, made up of 86 families living in 71 houses. There are two distinct sectors of the community, "La Plaza" where 40 families live and "La Escuela" where 46 families live. There are two existing community water supplies. The "La Plaza" sector is served by a drilled borehole equipped with rope pump while the "La Escuela" sector is supplied by a spring source with distribution system and communal tapstands. Both these systems were installed in 2005 by the Centro Humboldt. In addition to the community supplies there are around 36 private hand-dug wells in the community which draw water from fissured bedrock. These wells are generally not used for drinking water, following advice given to the community by MINSA and NGOs which have previously worked there.

The status of these water supplies in the dry season was discussed with community leaders. There was a certain amount of discussion and difference of opinion as to whether or not the spring source dried in the dry season. All were agreed that the borehole did not dry, but at times the rope pump was unable to deliver water because of the relatively shallow depth of the pump's bottom bearing in the borehole. Most of the hand-dug wells are dry from February to April each year. A small ephemeral stream runs through the community; when wells in the community are dry, water is sometimes collected from a well dug in the dry bed of the stream. This fills up with sediment during the wet season and has to be dug out annually. In addition to the existing water sources, a small hill was visited as a potential site for a water tank in case a gravity-fed water system were to be considered an option for the future. The location of all the sites visited is shown in the map below.



Various members of the community were asked to prioritise water needs and there seemed to be a consensus that improved access to water in the dry season for domestic and livestock use was a higher priority than water for irrigation for family gardens.

Subsequent to the site visit, Ing. Pedro López Pastora of the Centro Humboldt provided additional information on the borehole and spring at El Ojoche. According to Ing. López, the borehole does not dry and provides a reliable supply using the rope pump throughout the year. However, it produces a relatively low yield (4-5 gpm) and is not suitable for the installation of an electric submersible pump. The spring is perennial, according to Ing. López, maintaining a consistent flow of around 6 gpm throughout the year.

Options to improve water availability

There are conceptually two main options for improving the availability of water in the dry season at El Ojoche: develop a new or existing source to provide an adequate perennial supply or store water from the wet season for use during the dry season.

There appears to be limited capacity to increase the available supply from existing water sources in the dry season since the river dries and the yield of the borehole is very low. Although the spring reportedly maintains a consistent flow, it has a low yield which is already allocated to houses in “La Escuela”. It is possible that with improved spring capture and storage this source could provide a greater supply that it currently does, but this would need to be evaluated after monitoring flows in the dry season. Given its elevation, this spring could supply the area known as “La Plaza” by gravity as well as the existing houses served in “La Escuela” if the dry season flow were sufficient. Alternatively, water could be pumped to a storage tank above “La Plaza” (see map above) at times when it is not being used by the families in “La Escuela” and supplied to the community from there by gravity.

Options for developing new sources are more problematic. The construction of wells in the area with sufficient depth to ensure that they do not dry appears to be difficult and a new drilled borehole could be difficult to justify as if its yield were similar to the existing borehole, it would represent a poor return on the investment of drilling. The geological setting outlined above means that any attempts to drill would have a moderate to high risk of failure in terms of meeting demand. Detailed studies including geophysical surveys could possibly reduce this risk, but these would be very expensive in themselves. Another possibility could be the construction of a permanent shallow well and/or infiltration gallery in the stream bed so that water could be drawn from this source without the need to re-excavate the well in the stream bed each dry season. Again, monitoring of this water source during the dry season would be essential before this option could be considered.

The alternative option of collecting and storing water during the wet season for use during the dry season is tried and tested in other communities in western Nicaragua, although the initial cost of building storage tanks is relatively high. Water could be collected from any of the water sources available during the wet season: the stream, the spring, wells or rainwater. However, since sufficient water would need to be stored to last for several months, a single community system would need to be very large to meet the needs of the whole community and could be very difficult to operate and maintain for the benefit of everyone. Household water tanks are more feasible and avoid difficulties associated with rationing water. These tanks could be filled by rainwater (collected from roofs) or wells (manually pumped to fill the tanks) or a combination of both. All tanks should be covered to prevent light entering the tank and precautions taken to ensure that mosquitoes cannot enter.

Water storage tanks vary in size and materials. All options have advantages and disadvantages and costs vary considerably. There is rarely a "one size fits all" option, although it is usually convenient and more cost effective when implementing projects to benefit several households within a community to select a "typical" system which can be installed by all with only minor modifications to accommodate the particular conditions encountered in each house. The principal options are:

Material	*Capacity (litres)*	*Approx. cost (US$) inc.tax*	*Advantages*	*Disadvantages*
Plastic	2,500	380	Prefabricated, easy to install, durable, readily available, movable, cheapest option for smallest sizes	Difficult to transport, can be damaged, expensive in larger sizes
	5,000	800		
	10,000	1,700		
	15,000	4,500		
	22,000	5,000		
Steel tanks (refurbished)	2,500	700	Prefabricated, easy to install, movable	Difficult to transport, require maintenance, expensive in smaller sizes
	5,000	1,000		
	10,000	1,500		
	20,000	2,300		
Ferrocement (materials only - not including labour)	5,000	450	Use local materials and skills, durable, cheapest option for larger sizes, very large sizes possible	Requires most time and effort to construct (3-8 weeks), requires training and supervision, cannot be moved
	11,000	1,100		
	16,000	1,400		
	23,000	1,600		
	71,000	2,500		
Collapsible fabric tanks (designed for emergency use)	2,000	1,100	Very easy to transport and install, movable	Expensive, easy to puncture, not designed for long-term use, only available from specialist suppliers
	5,000	1,400		
	10,000	1,600		
	15,000	1,800		
	20,000	2,000		
Steel panel tanks with rubber liner (designed for emergency use)	11,000	2,700	Easy to transport, installation in a few hours, durable, movable, very large sizes possible	Expensive, only available from specialist suppliers
	45,000	5,200		
	70,000	5,800		
	95,000	6,500		

Selection of the most appropriate tanks will depend on whether the installed tank is intended to be permanent, where it will be located, the availability of labour and the capacity required. Design of the capacity of the tank is an inexact science, but requires careful planning. It is important to assess both how the tank will be filled (supply) and how the water will be used (demand). In the case of tanks for rainwater harvesting, the total annual precipitation, the distribution of precipitation throughout the year and the area of roof are both important factors on the supply side, whereas household water use and/or water requirements for irrigation of family gardens need to be assessed on the demand side. An example of such a calculation from a rainwater harvesting project in San Jacinto is attached. Monitoring of the use of these tanks in the three years since they were constructed has shown that the design capacity is slightly too large and tanks of 27,000 litres rarely fill completely. The 'typical' tank size now constructed is 23,000 litres. Since the annual rainfall used in this calculation was 1400 mm which is the same as the estimated annual rainfall for El Ojoche described above, it may be reasonable to assume that household tanks for rainwater harvesting for domestic use in El Ojoche would also need to be around 23,000 litres, so long as the typical roof area is also around 47 m^2. If wells were also to be used to fill the tanks, larger capacities would be possible.

Ferrocement water tanks for rainwater harvesting have been built by Nuevas Esperanzas in the community of San Jacinto since 2005 and provide a good source of water throughout the year, where water use is appropriately rationed. 24 domestic systems have been constructed as well as four in churches, two in schools and one in a health centre. In general the domestic systems are managed better than the systems in public buildings, although some churches have also managed their systems reasonably well.

If the tanks were to be used for irrigation of family gardens, further calculations of demand would be necessary. Some references obtained for drip irrigation water demands for climate and soil conditions typical of the region suggest that 25 m^2 of tomato would require 15 m^3 of water for the growing season. The same area of pepper would require 25 m^3 and the same are of cucumber would require 14 m^3. The size of garden and capacity of tank should be designed taking into account the area and crops to be planted, as well as the area of roof available to fill the tanks. An alternative which uses considerably less water is hydroponics. This requires specialist knowledge, but the technique is practised in Nicaragua and a hydroponics project for small-scale family gardens is currently being developed through a project funded by FAO. Technical advice may be available if this option were to be considered.

Conclusions and recommendations

The location of the community of El Ojoche presents some challenges with respect to the availability of water during the dry season. Whilst the community has a number of different water sources available during the wet season, only a spring and a drilled borehole can provide water throughout the year. The yield of these sources in the dry season is not certain but appears to be relatively modest. Drilling a new borehole would be risky and may not provide significant benefits to the community. More effective use of the spring source could help to alleviate some of the water problems faced by the community, as could a well and infiltration gallery to pump water from the dry stream bed, but both of these options would require further investigation in the driest months of the dry season. The alternative option is to install household storage tanks (covered and sealed) to store rainwater and/or groundwater collected during the wet season for use during the dry season. Various options are available, although ferrocement tanks are the most cost effective for larger capacities. The disadvantage of these tanks is that they require time to build and a significant commitment of labour. Tank size needs to be calculated carefully and may depend on whether the water is to be used for irrigation or domestic use.

It is recommended that further investigations of the spring, stream bed and drilled borehole are made in March/April to determine whether or not the yield from these sources can be improved. It is also recommended that demands for water in the dry season be prioritised with the community. If the highest priority for the community is water for household use, a project which provided water only for irrigation may be inappropriate or open to abuse. Water demands should be quantified and tank capacities calculated. It is recommended that if ferrocement tanks are to be constructed, significant attention be given to community participation as the commitment of labour required is considerable. Further advice on rainwater harvesting and the construction of ferrocement tanks is available from Nuevas Esperanzas.

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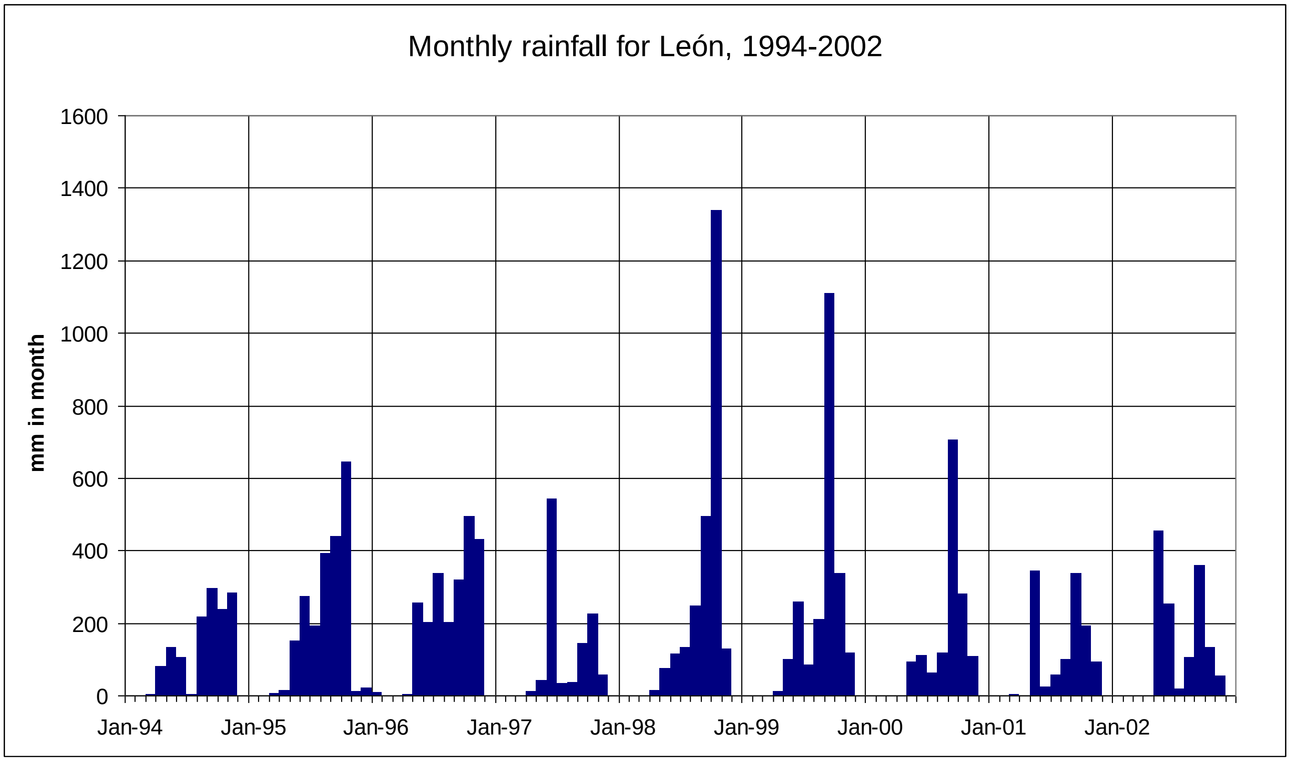
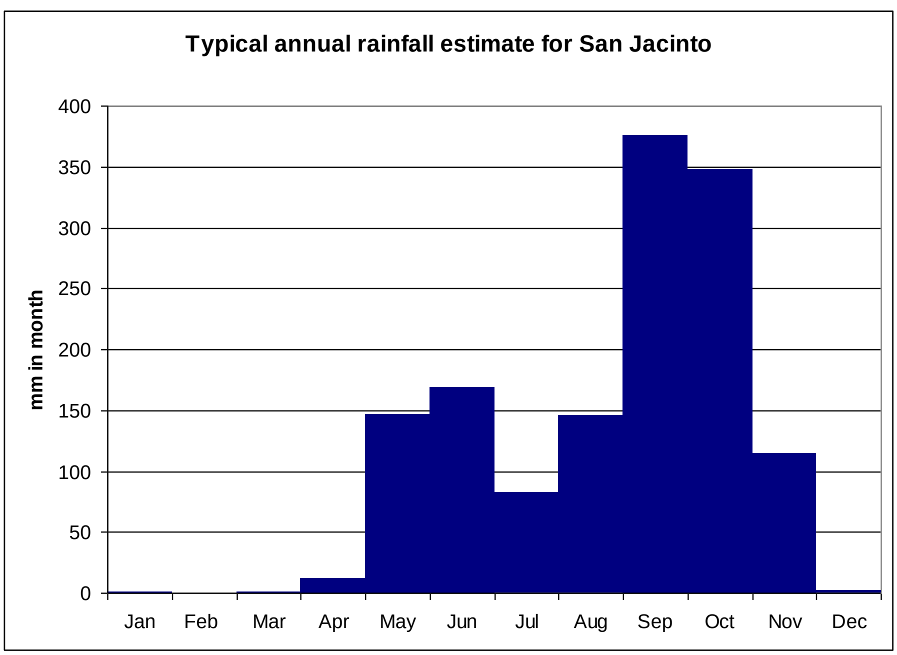
Calculation of supply/demand for rainwater harvesting project in San Jacinto

The mean annual rainfall for the period 1994-2002 in León was 1738 mm and the distribution of this rainfall is shown in the graph below:



A reasonably conservative estimate of annual rainfall for San Jacinto based on isohyet maps of 1400 mm was used to calculate a typical annual cycle for San Jacinto rescaling the time series data for León. This is shown in the graph below:



It can be seen from this cycle that there are five months of the year that are effectively completely dry and thus a design criterion for rainwater storage was that the tanks should be large enough to store sufficient water to meet a basic minimum household demand for 150 days. This was calculated for each household using a national standard for rural water supply of 30 litres per person per day.

However, it was also important to take into account the size of roof and its potential to fill the tank. Most houses have limited roof areas and in some cases have the potential to collect only the equivalent of two tanks full of water during the year. Since rainwater would be used during the wet season and not just stored for use during the dry season, it was considered that the tanks should not be larger than half the volume of rainwater that could be harvested by the roof in one year.

Taking into account the rainfall and roof areas, it was decided that a typical household water tank should be built to hold 27 m^3. The graph below illustrates the 'water budget' of a typical household system at San Jacinto calculated using the annual rainfall estimate given above.