

## THE DIVINE FLOW: WATER MANAGEMENT AT CHICHEN ITZA

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The archaeological site of Chichen Itza rests on a slightly undulated and mostly karstic land, with an easy access to water sources that lie at an average depth of 22 to 25 m. The vegetation around the site consists of woodland of an average height with abundant fallen leaves between the months of February and May (Schmidt 1981:55). The fundamental reason for choosing the localization of the ancient city was, no doubt, the natural water springs as well as the good agricultural lands that surrounded the area. This was clearly reflected in the architectural layout of the metropolis: from the core, there were causeways that led to much elaborated and decorated groups, both formal and residential, that followed the architectural pattern of the center, and in turn, many of them were placed in the vicinities of a particular cenote or of a certain *rejoyada*. Likewise, the builders took the maximum advantage of the lower sections and created, when making artificial elevations, inclined planes to collect water through different water systems that allowed water to flow towards adequate storage deposits, or simply, to prevent the plazas from flooding during the rainy season.

With time, the abandonment of Chichen Itza and the collapse of its buildings that fell down on the platforms where they had been built, did not allow for delineating any clear notion on the exploitation of water established by the Maya in this place; references were available only in regard to the use of cenote waters by the local population. The recent excavations that revealed civil works connected with water transportation and management, have led to corroborate that this was a relevant and special issue in the development of Chichen Itza.

As power instruments and instruments of power, the systems for water impound were used, logically, to favour the settlement in those areas close to the access to underground water sources. Both the development of the city and the demand of a growing population likely influenced the search of new drinkable water and audacious techniques to obtain it, through specialized, high quality labor. These works include water canals to areas adapted for water retention and the construction of chultuns, thus securing the water supply for the population. If Chichen developed and dominated a large portion of northern Yucatan, it was probably largely due to the control they exerted on water. Only a powerful political organization may have accomplished outstanding public works to provide service and to satisfactorily respond to the needs of a city.

## **WATER MANAGEMENT AT CHICHEN ITZA**

The geological substratum of the state of Yucatan is of a marine sedimentary origin, composed of calcite and in a lesser degree of dolomite and dragonite, whose origin dates to the Middle Eocene. On the ground surface there is a hard lime layer (slab), under which there is a soft water bearing material, also present on the walls of several cenotes, permeable but well capable of retaining humidity, an important issue in regard to agricultural use.

Diego de Landa, when referring to the terrains of the peninsula, called them "*those with the least earth*" (Landa 1983); it is distinguished for having a relatively flat configuration, scarce altitude above the sea level, a slight inclination of its slopes, and slight topographic contrasts. In the northeast area of the state, in particular, there are depressions locally known as cenotes, hollows or rejoyas (*coop o k'om*), as well as aguadas, originated in the disintegration of the calcareous layers of the subsoil. One distinctive characteristic is the degree of disintegration of the superficial calcareous layer, not too thick and with a remarkable filtering capability, together with the occurrence of internal galleries formed by fissures of different sizes and circular holes of different diameters (sartenejas), still used to hold water (Duch 1988).

This calcareous layer supplied –in the form of hard lime and chert inclusions– materials for the elaboration of tools used in agricultural and domestic works, for hunting, fishing, and for warfare activities. It provided the foundations for the erection of prehispanic cities and their satellites, as well as the roads that connected them to one another. In turn, and because of its constitution, it also limited and has limited the development of agriculture, so that peasants had, and have had great courage to make it produce, based only on the knowledge they had of the rainy season and the different types of soils to make it produce.

There are no superficial water flows in the area, but instead, there are voluminous underground water-bearing strata. The average amount of rain water in Chichen may climb to 1200 mm, with a random rainfall regime distributed in average 80 days a year. The total humidity available during the rainy season is more than enough to cover the water requirements, both of the wild vegetation and the species that grow in the floodable depressions, and it even allows for a second agricultural cycle without the need to provide any kind of additional watering. However, we should keep in mind that accidents and climatic catastrophes such as droughts and hurricanes are also frequent, as well as the loss of crops caused by plagues and diseases.

## **SUPPLY AND WATER IMPOUNDING WORKS**

It is frequently seen that the names of ancient prehispanic locations make reference to their geographic situation: the name Chichen Itza, although not genuine but indeed old, establishes a clear reference to its localization next to the Sacred Cenote: "*at the banks of the Itza's well*". Perhaps the original name of the site was

*Yabnal*, which may translate as “*the place of abundance*” (Schele and Mathews 1998), a phrase that could as well refer to the water resources from which local inhabitants benefited. In any case, the history of the place has always been connected with water. The role it played was so important that references are abundant in pictorial representations, relief works, sculptures and buildings, where it is always a favorite and recurrent subject.

With the resources now at hand, we shall try to frame the vital liquid within the development of the city both through the natural sources and the civil supply works with their particular variants.



Figure 1. Upper section of the Sacred Cenote, Chichen Itza.

## NATURAL SOURCES

### CENOTES

It is not widely known that the large city of Chichen Itza was built around an area relatively rich in natural water sources, with a total of 13 large cenotes documented in a area of little more than 25 km<sup>2</sup>, the most important of which are the cenote of Xtoloc, the cenote of Poxil, the cenote of Xnaba, the cenote of Holtun, the cenote of Cunanchen, and the cenote of Cumtun, to mention just a few, wherefrom water was obtained for the crops or the different needs of the population. The Sacred Cenote, particularly, located north of the Castle, and after which the modern city was named, was used, like historic sources say, as a large receptor of offerings and rituals of different character, and was and has been a relevant peregrination center up to very recent times (Figure 1). The role it played in the ancient Maya world was so crucial that Bishop Landa compared Chichen Itza with Mecca, or with Jerusalem (Landa 1954).

## REJOYAS

The rejoyas or hollows, natural depressions of the terrain, are also an important part of the geographic landscape in Chichen Itza. Although they usually do not contain water, when rainfalls are heavy they can hold it and many of them were adapted to this purpose. Due to the humidity they keep, they were also used (a function that has been maintained to this day), like adequate places where to grow crops for the population. The case is similar with the aguadas, although they are not too frequent in the area.

## CAVES

Caves, with or without water, formed by special environmental processes on the limestone, were use to exploit construction materials, like temporary shelters, and to obtain the precious liquid. Often times this water was used for special ceremonies (and has been referred to as “virgin water”), for being little contaminated by the external elements. One important and widely known cave is the Balamkanche cave, with a *sacbe* that connects the cave with Chichen Itza and which extends over a distance of 3 km. Surrounding this cave, there still are impressive prehispanic structures that once formed one of Chichen’s satellite groups (Figure 2).



Figure 2. Interior of the Balamkanche cave.

## **SARTENEJAS**

The presence of sartenejas is common whenever one crosses the growing fields and the not too much looted areas around the place: they are small cavities formed by erosion, located primarily on the elevated rocks, irregular in shape, and which retain rain waters. This water was used, and still is today, to wash tools, for the animals, and in desperate cases, considering that the liquid is not too clean, to satiate thirst. Many of them are associated with ephemeral constructions, or are found at the edge of the *sacbeob*.

## **FOUNTAINS AND ARTIFICIAL CANALIZATIONS**

With a privileged situation in the northern area of the Yucatan peninsula, considering that it receives 1200 mm or more of rain a year, the inhabitants of Chichen Itza used to adequate passages in their environment and their buildings, to impound the largest possible volume of liquid.

## **PLAZAS**

In general, when erecting the groups of important buildings on top of artificial platforms, the Chichen Itza builders took great care in creating drops that directed the water toward drainages to prevent floods during the rainy season. These drainages were oriented towards lower terrains, and occasionally, to depressions, which presumably were adapted to receive and retain the precious fluid. The plazas at the site centers were profusely stuccoed, thus propitiating that water could run easily through the canals and to the water reservoirs, a common characteristic in cities of both the Lowlands and the Highlands within the Maya area, and of other areas in Mesoamerica.

As a complement, in some of the plazas water was not specifically carried to these canals, but instead, it was absorbed at the heart of the construction core through stone rings with conical lids. Then, the liquid was drained to the natural land. Logically, the purpose of this system was to prevent floods, and this kind of drainage is clearly represented in the esplanade of The Castle, in the Group of the Thousand Columns, the esplanade of the Initial Series Group, and the Southwest Main Group, to mention only the case of some relevant plazas at the site.

One particularly outstanding example was discovered during the 1993 and 1994 excavations conducted at the group known as Group of the Thousand Columns, on top of the central Great Leveling of the site, east of The Castle. The most relevant architectural features of this group include the North Colonnade (2D10), the *Ahau Balam Kauil* Colonnade (3D5), the Northeast Colonnade (3E1), and the Plaza of the Masks. This entire grouping exhibits different construction stages, one of its limits being the edge of one of the largest rejoyas found in the area. This hollow, located northeast of the plaza and at the back of the NE Colonnade (3E1), is almost 9 m deep and for what it seems, its surface was stuccoed even in its internal part, thus

preventing the absorption of rain waters; furthermore, the drainage of roofs and plazas converged towards this point (Carillo and Osorio 1995).

This section featured a wall section placed adjacent to the joining of the buildings, with the probable function of a buttress. In the wall that looks at the east of this ledge, there was some kind of sluice or opening, which proved to be the mouth of an elaborate draining canal. This canal has a total length of 64.20 m. It begins in front of the eastern stairway of the North Colonnade (2D10) that faces the plaza, and its interior height varies from 0.20 m to 0.69 m, considering a drop to direct the water towards the rejoya. This is one of the most complex examples as far as water works is concerned at the site: the foundations were laid under the level of the Plaza of the Thousand Columns, and on its surface, three rings or hoops were perforated to drain the rain water from the plaza itself (Figure 3).

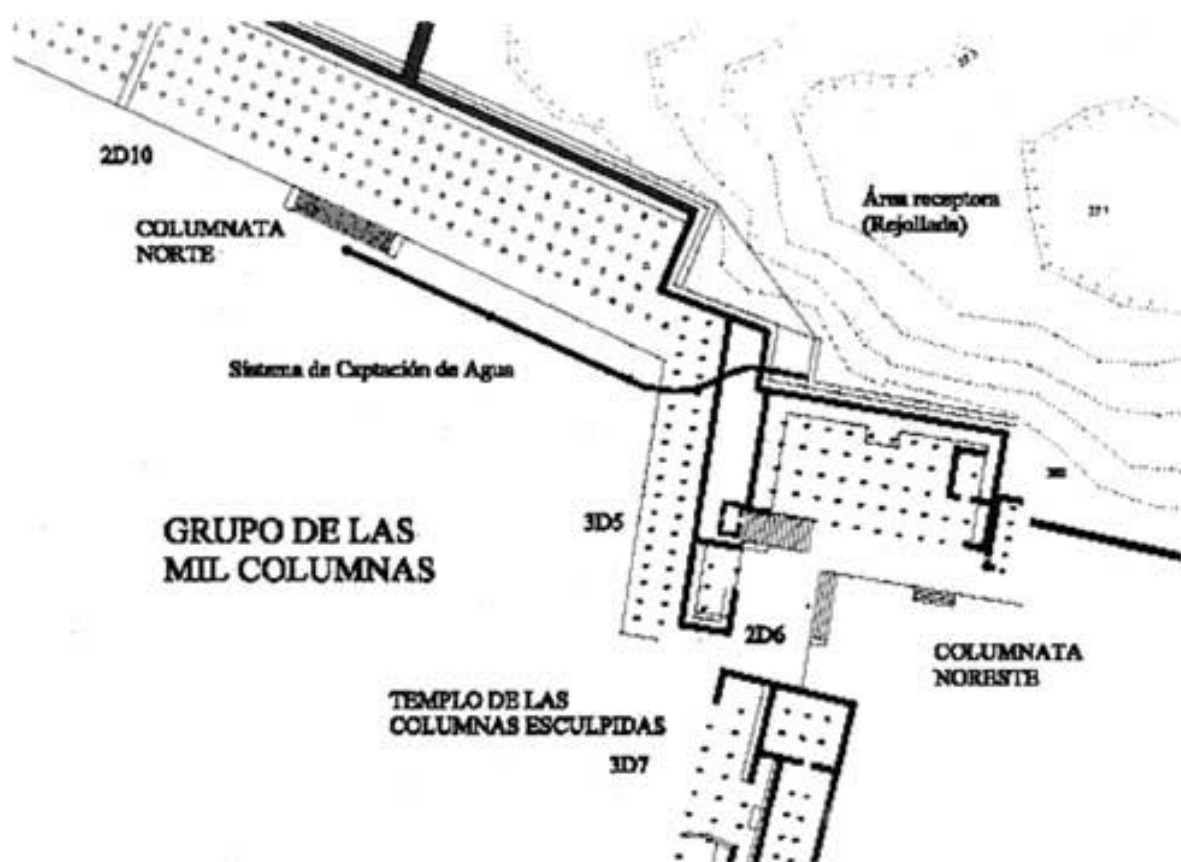


Figure 3. Floor plan of the Group of the Thousand Columns.

The canal integrates the construction system of the leveling, and extends under the *Balam Ahau Kauil* Colonnade (3D5); as the plaza was progressively enlarged, the canal was prolonged to achieve its present length. At the lower level of the sluiceway, a second canal 4.50 m long was built at the interior of the foundation that surrounds the leveling, built to receive the torrent of water that came from the sluiceway and to further take it to the rejoya.

Both canals were built with carved stones in the form of ashlar for the walls; for the floor and roofs, they used stones similar to those used as capstones, covered with stucco to prevent leaks. One interesting piece of information was revealed in the drainage walls, as it was observed that they included stones with relief decoration and remains of polychromy that were reused after being torn apart from their original position in some building with mural decorations.

## **BUILDINGS**

Like a typical feature of the architecture at the site, there are certain modifications in the buildings and their flat roofs aimed at providing a drop for rain waters, to prevent stagnation in the buildings, and water from emptying in the plazas and esplanades of the city. For the same reason, drops and perforations were made on the stucco floors inside several structures, with embedded vessel fragments (necks and handles, mainly) to direct the water to the outside. As an example, we may mention the drainages found in Structure 4D6 (Francisco Pérez, personal communication 2003, and in the Palace of the Sculpted Columns or 3D7 (Carrillo and Osorio 1995).

Also, the flat roofs of buildings were adapted to collect rain. There is one example in the structure known as Casa Colorada (*the Red House*) with a gargoyle located *in situ* and now in a very poor condition and total disuse. It consists of a canal made with carved stones placed in the upper molding of the structure, in combination with the capstone of the roof and showing a groove. The stuccoed surface of the roof features as well a stone ring.

In general, these drainage gargoyles were not preserved in their original place due to the collapse of the buildings; however, their incidence has been noted ever since the initial investigations conducted in Chichen Itza and other sites within the Maya area. Recently, these grooved stones were found in excavation contexts and restored to their original place, as is the case of the Complex of the Phalluses (5C14), the House of the Snails (5C5), and the Gallery of the Monkeys (5C6), within the Initial Series Group, where they have been rehabilitated and now drain the water of the consolidated flat roofs. The gargoyle at the Gallery of the Monkeys drains directly towards the impound platform of Chultun 3, located at its east side, and was recovered during the excavation of this cistern (González de la Mata 2003). The perforated stone in the upper cornice was found in the rubble, in its exactly corresponding place.

Another type of adaptation used frequently, are the open canals elaborated directly on the stucco floors generally associated with residential structures, used to evacuate the water to the outside. One clear example of this is found in the residential group located at the north end of the Initial Series Group in Structure 5C33, where a canal was excavated on the stucco floor of the structure to carry the water to Chultun 1, located in front of the entrance (Figure 4). Furthermore, there is another one documented in Structure 4D6, together with the peculiar piece of information regarding Structure 22Z1 in the town of Pisté, whose inner floors formed a concavity when they reached the walls, as opposed to an angled corner, to evacuate the water towards the entrance (Francisco Pérez, personal communication

2003). Little stucco flanges crossing the openings of doors and corridors also had the very logical function of preventing uncontrolled floods and the free draining of water. They occur at the Complex of the Pahluses (5C14), and at the Gallery of the Monkeys (5C6). This feature is observed since very early in time at the site, with the example of the Substructure of the Stuccoes (5C4-l) recently discovered and associated with the ceramic complex of Yabnal-Motul, from 600 to 800 AD (Osorio 2002).

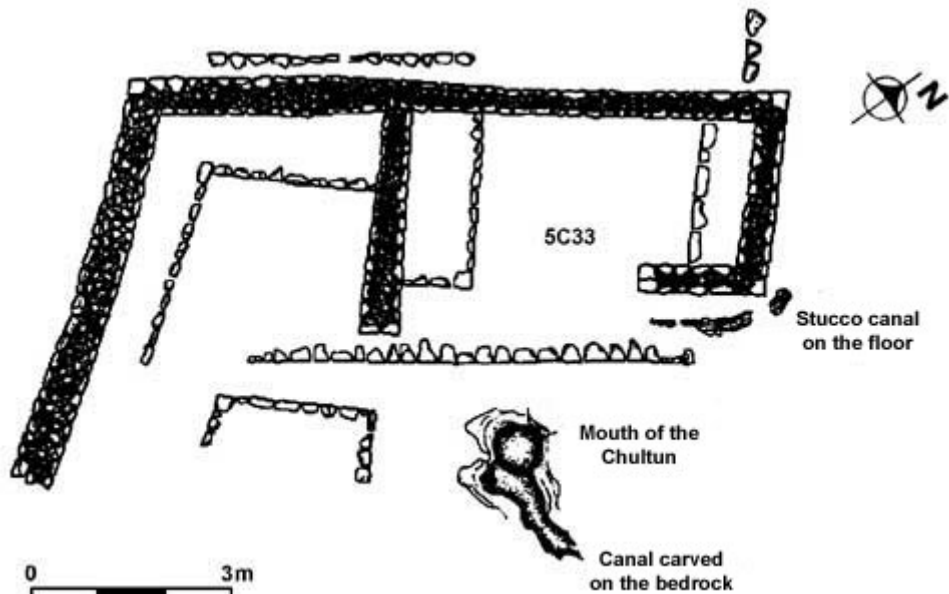


Figure 4. Chultun and canalizations in the Initial Series Group.

Together with the architectural details described so far, in Chichen Itza and for the time being, we only know of two types of buildings with a function directly associated with water: the structures known as Sweat Baths, built with an obvious medicinal and purifying purpose, which made use of a water-vaporizing system that was directed to the inner chamber of the building by means of ditches located on the floor. The most important and renowned sweat bath is the one located on the south edge of the Sacred Cenote, but there is another one near the entrance of *Sacbe 6* (Structure 3E3), and still another smaller one at south of the platform of *The Snail* (3C15); the latter is in close association with an elaborate underground, cistern-type deposit. One additional structure directly related to water is the one known as *The Market*, featuring as a particular trait a sunken patio that retained the water that fell from the roof, with a drop oriented towards it. This patio also had a drainage which in turn, could be used to clean up the area.

## RAMPARTS AND FOUNDATIONS

Also, it is possible to observe drainages in some short constructions that pull up directly on the stuccoed elevations, for example, in the ramparts that delimit and protect the main groups of the site. Additional canalizations, built with the clear purpose of avoiding floods, are present in the north and south headers of the Great



Ballgame, and in the Observatory or Snail, where the low wall delimiting its upper platform features different sluices at the floor level. Right in the general foundation of this building, two large openings, one on the south side and the second one towards east, served to drain the upper esplanade: these sluices were integrated to the upper molding that faced the outside. The first directed the water towards some low structures, whose function might have been of the residential type, while the one at east headed towards a depression of the ground of a regular size outside the plaza leveling.

## **SACBEOB**

The water works were not limited to buildings and plazas; the *sacbeob*, besides having been artificially raised to evade the bajos they crossed, and leveled with the hillocks they found on their way, represented as well an adaptation in their construction to prevent large water stagnations. This adaptation consisted, in most of them, of canals that crossed them width-wise, with two sluices that allowed water to drain towards the lower level of the ground. *Sacbe 5*, which communicates the Group of the Castle with the Observatory; *Sacbe 74*, with two documented canals, which communicates the Group of the Sculpted Panels with the Great Leveling through door 6; and *Sacbe 78*, connecting *Sacbeob 79* and *80*, are outstanding examples of this category. A different form is observed in *Sacbe 32*, where there is a lateral stairway with a canal under its steps, to prevent water stagnation in the joining corner of the Group of The Little Heads platform (3E19).

## **WATER WELLS**

Although in some other archaeological zones, both from the Puuc, the Chenes region and the north plains there were artificial wells intended to reach the water level at the bottom of the rejoyas or on the superficial slabs, Chichen features, for the moment, just one such example. It is located at the north section of the site, adjacent to the Group of the Lintels and inside a huge rejoya whose bottom was adapted with coarse stone retaining walls to prevent the organic residues of the surrounding vegetation from reaching the well. The well is integrated by walls with 17 courses of tightly packed stones, a diameter of 1.78 m, and a depth of 4.20 m down to the water level (Figure 5). The ceramic material recovered during the investigation allows for inferring that it was built and used since way back in time in the history of Chichen, a fact that has been corroborated through the archaeological materials obtained in the nearby Group of the Lintels, defining there a heavy occupation since probably 650 AD. Ancient legends of the region refer that this was the home of an “*old woman*” who saved Chichen during a terrible drought (oral information from Jorge Pool Poot, from Xcalacoop, 2003), thus suggesting that the knowledge and relevance of the well was preserved not only until the end of the great city of Chichen, but in a way, to our days.

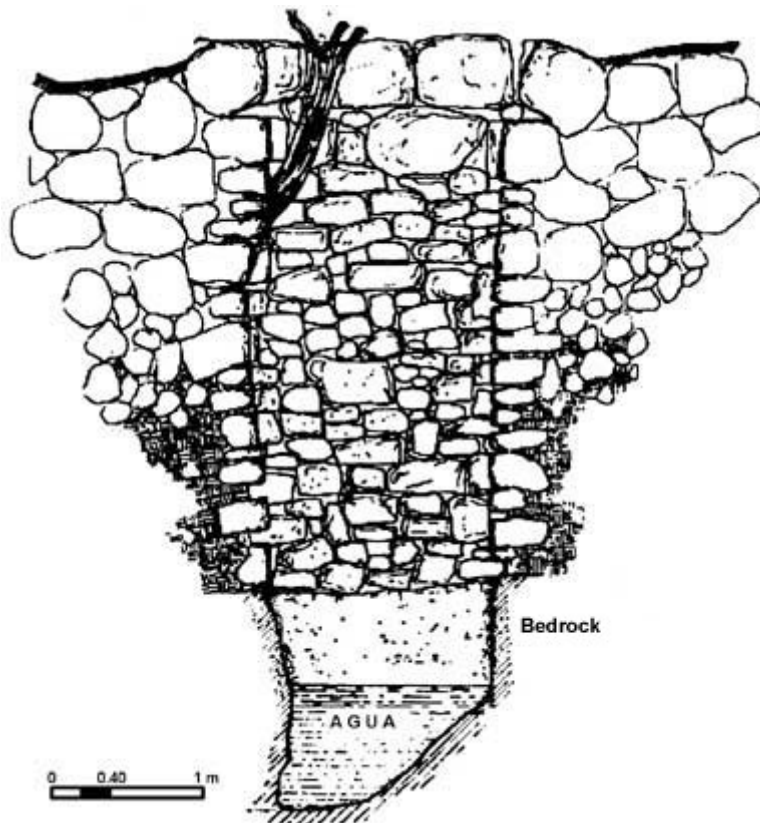


Figure 5. Water well nearby the Group of the Lintels.

## **CHULTUNS**

Alike the Maya of almost all sites from the great northern plain and the Puuc, the inhabitants of Chichen Itza found a solution for the challenge that represented the absence of superficial water during the long periods of drought, through an ingenious construction system of underground cisterns. The manufacture of such features involved breaking the upper limestone layers and excavating the lower and softer rocky deposits, to obtain the form of a big and usually asymmetric bottle. The main characteristics of the chultuns included stucco walls to prevent water from leaking, the adaptation of an impound area and the perforation of canals to carry the fluid to the deposit, the curbstone, and the lid.

One particularity of Chichen Itza is that most chultuns were greatly elaborated and lined with finely carved stones, most of all those located in the vicinities of major groups and within the platforms and artificial levelings. Those located in residential zones were smaller in size, and showed canal adaptations directly carved in the rock, to direct the water towards the chultun, without the need of having a large impound platform. Studies on storage capacity are in progress, combined with data on the duration and water volumes established for a certain number of people. This type of water impound works have spread all over the Maya zone, and probably its origins could be traced back to the first settlements in the area, which lacked or suffered the shortage of the vital fluid.

## FINAL CONSIDERATIONS

The planning for the construction of the ancient city of Chichen Itza takes into account practical considerations for the needs and comfort of its inhabitants, a fact that is made evident in the excavations conducted at the site in previous years. Even though at the beginning the settlement did not have the dimensions it achieved in the following centuries, it is a fact that a very clear idea already existed at the time of planning the city: this is evident when one walks around and analyzes the different artificial platforms on top of which the buildings were erected, both at the central core of the site (Great North Leveling), and in the other major dependant groups, connected by an elevated network of roads (*sacbeob*) that facilitated the transit of residents, goods, traders and rulers all the year round, due to the drainages and the planning of additional elevated surfaces everywhere.

Although the draining and canal systems described in this summary correspond to the final stage of development of this large city, it is hypothesized that from the very beginning of the settlement there was an awareness of how important water procurement was, and how floods were to be prevented. This accounts for the creation of the artificial platforms on which the main buildings were constructed. At the time of leaving these levelings –a pattern reproduced by the terminal satellite groups-, it also becomes apparent a whole scheme of ramifications for the *sacbeob*, probably created so that the inhabitants who had their homes around the primary groups could move along the main roads skipping the puddles that appeared in the rainy season, during hurricanes or storms. It should be noted that all these *sacbeob* were elevated on the ground, and only there where they came across a rocky hillock they were reduced to mere alignments for a lateral delimitation with a free and smoothed surface.

The amount of effort and labor involved in these elevations reveal the great significance dwellers gave to the forces of nature, and how, through different civil works, they managed to take advantage of the environment to obtain water, the control and distribution of which probably demanded a well established social organization at a family or group level. It was a crucial objective, both for rulers and peasants, to maintain productive crops to prevent famines that could easily give way to social upheavals, thus jeopardizing the stability of the city.

An additional consideration worth bringing forward is that the overall settlement pattern, the attention to detail, and the elaboration of the solutions described here, are a strong argument to suggest that the early inhabitants and builders of the large city of Chichen Itza were very familiar with the local environment where they developed. They do not seem to be foreign invaders from a very different environment, a notion posited several times.

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Figure 1 Upper section of the Sacred Cenote, Chichen Itza.

Figure 2 Interior of the Balamkanche cave.

Figure 3 Ground plan of the Group of the Thousand Columns.

Figure 4 Chultun and canalizations in the Initial Series Group.

Figure 5 Well in the vicinities of the Group of the Lintels.