

# Grids & Datums

## STATE OF BAHRAIN

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"Bahrain's history goes back to the roots of human civilization. The main island is thought to have broken away from the Arabian mainland sometime around 6000 B.C. and has almost certainly been inhabited since prehistoric times. The archipelago first emerged into world history sometime around 3000 B.C. as the seat of the Dilmun trading empire. Dilmun, a Bronze Age culture that lasted some 2,000 years, benefited from the archipelago's strategic position along the trade routes linking Mesopotamia with the Indus Valley. In the midst of a region rapidly becoming arid, Dilmun's lush spring-fed greenery gave it the image of a holy island in the mythology of Sumeria, one of the world's earliest civilizations, which flourished in what is today southern Iraq. Dilmun had a similar cachet with the Babylonians, whose *Epic of Gilgamesh* mentions the islands as a paradise where heroes enjoy eternal life. Some scholars have suggested that Bahrain may be the site of the biblical Garden of Eden.

"Dilmun eventually declined and was absorbed by the Assyrian and Babylonian empires. The Greeks arrived around 300 B.C., giving the islands the name Tylos. Bahrain remained a Hellenistic culture for some 600 years. After experimenting with Christianity, Zoroastrianism and Manichaeism, in the 7th century many of the island's inhabitants accepted the personal invitation of the prophet Mohammed to convert to Islam.

"After a series of Islamic rulers, Bahrain was conquered by the Portuguese in the early 16th century. The Portuguese used the island as a pearling port and military garrison. In 1602, the Portuguese governor made the fatal mistake of executing the brother of one of the island's wealthiest traders. The trader, Rukn El-Din, proceeded to lead an uprising that soon drove the Europeans from Bahrain. The island then became part of the Persian Empire, but that association was cut short by the arrival of the Al-Khalifa clan, Bahrain's current ruling family.

"In the 1830s, Bahrain signed the first of many treaties with Britain, who offered Bahrain naval protection from Ottoman Turkey in exchange for unfettered access to the Gulf. This arrangement kept the British out of Bahrain's internal affairs until a series of internecine battles prompted the British to install their own choice for emir in 1869" (*Lonely Planet, 2007*).

"Persian ownership was denied by the British in 1928; oil was discovered in 1932, and Bahrain established a Council of State in 1970. It became a member of the United Nations in 1971, and with five other Arab states Bahrain joined the Gulf Cooperation Council in 1981" (*Merriam Webster's Geographical Dictionary, 3rd edition*).

Bahrain is an archipelago in the Persian Gulf and is east of Saudi Arabia. It is 3.5 times the size of Washington, D.C., and has a total coastline of 161 km. The terrain is mostly low desert plain rising gently to a low central escarpment. The lowest point is the Persian Gulf (0 m), and the highest is Jabal ad Dukhan (122 m).

Topographic maps of Bahrain have been produced as early as 1825 at a scale of one inch to two miles. The British Directorate of Military Survey produced maps at a scale of 1:253,440 from original surveys in 1915-1917. Since that time the Directorate has also produced town plans for populated places in Bahrain. A map of Bahrain Island was produced by the Directorate of Military Survey, the British War Office and Air Ministry in 1968 at a scale of 1:63,360 (one inch to one mile) with the UTM grid overprinted. This polychrome map supplied complete coverage of Bahrain and Muharaq Islands. Relief is indicated by contours at 20-foot intervals and was compiled from 1951-1953 aerial photography by Hunting Aero-surveys, Ltd., based on control by Bahrain Petroleum Co., Ltd. (BAPCO).

The classical geodetic datum used for Bahrain is the Ain el Abd Datum of 1970 located in the "Arq" Oil Field of Saudi Arabia where:  $\Phi_0 = 28^\circ 14' 06.171''$  N,  $\Lambda_0 = 48^\circ 16' 20.906''$  East of Greenwich, thanks to the EPSG Database, and the ellipsoid of reference is the International 1924 where:  $a = 6,378,388$  m and  $1/f = 297$ . Thanks to some correspondence I had in 1998 with Andrew Kopec, the GIS Manager for the Bahrain Centre for Studies and Research, the local grid system used by the Ministry for Housing is a Transverse Mercator where the central meridian,  $\lambda_0 = 51^\circ$  E, the latitude of origin  $\phi_0 =$  Equator, the scale factor at the latitude of origin  $m_0 = 0.99962$ , and False Easting = Zero, and the False Northing = 2,000 km. According to Kopec, the main product is a 1:1,000 scale topographic map. The same datum and projection is used on marine charts produced by the same ministry at scales of 1:25,000, 1:50,000, and 1:100,000.

The only local transformation parameters I could find were published in the now obsolete TR8350.2 where: from Ain el Abd 1970 to WGS84 are:  $\Delta X = -150\text{m} \pm 25\text{m}$ ,  $\Delta Y = -250\text{m} \pm 25\text{m}$ ,  $\Delta Z = -1\text{m}, \pm 25\text{m}$ , and the solution is based on only two points.

There are two treaties that have been negotiated among Bahrain, Saudi Arabia, and Iran regarding the division of the mineral resources of the Persian Gulf (continental shelf). Both are variations on the "equidistance principle" of the International Law of the Seas, but are acceptable and valid under International Law as all three participating high parties are in agreement. (See *Department of State, Office of the Geographer, "Limits in the Seas, No. 12 and No. 58."*)



The contents of this column reflect the views of the author, who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the American Society for Photogrammetry and Remote Sensing and/or the Louisiana State University Center for Geoinformatics (C<sup>2</sup>G).