Network distribution for water supply optimization at Monterrey, Mexico

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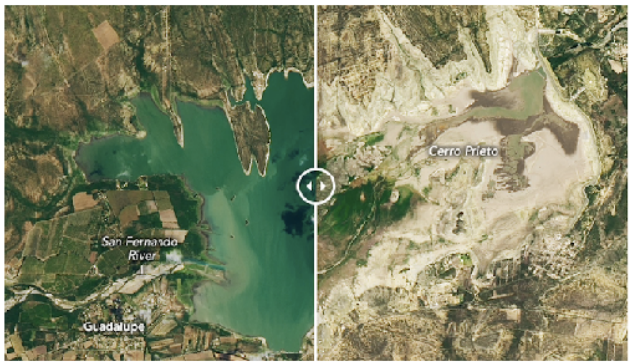
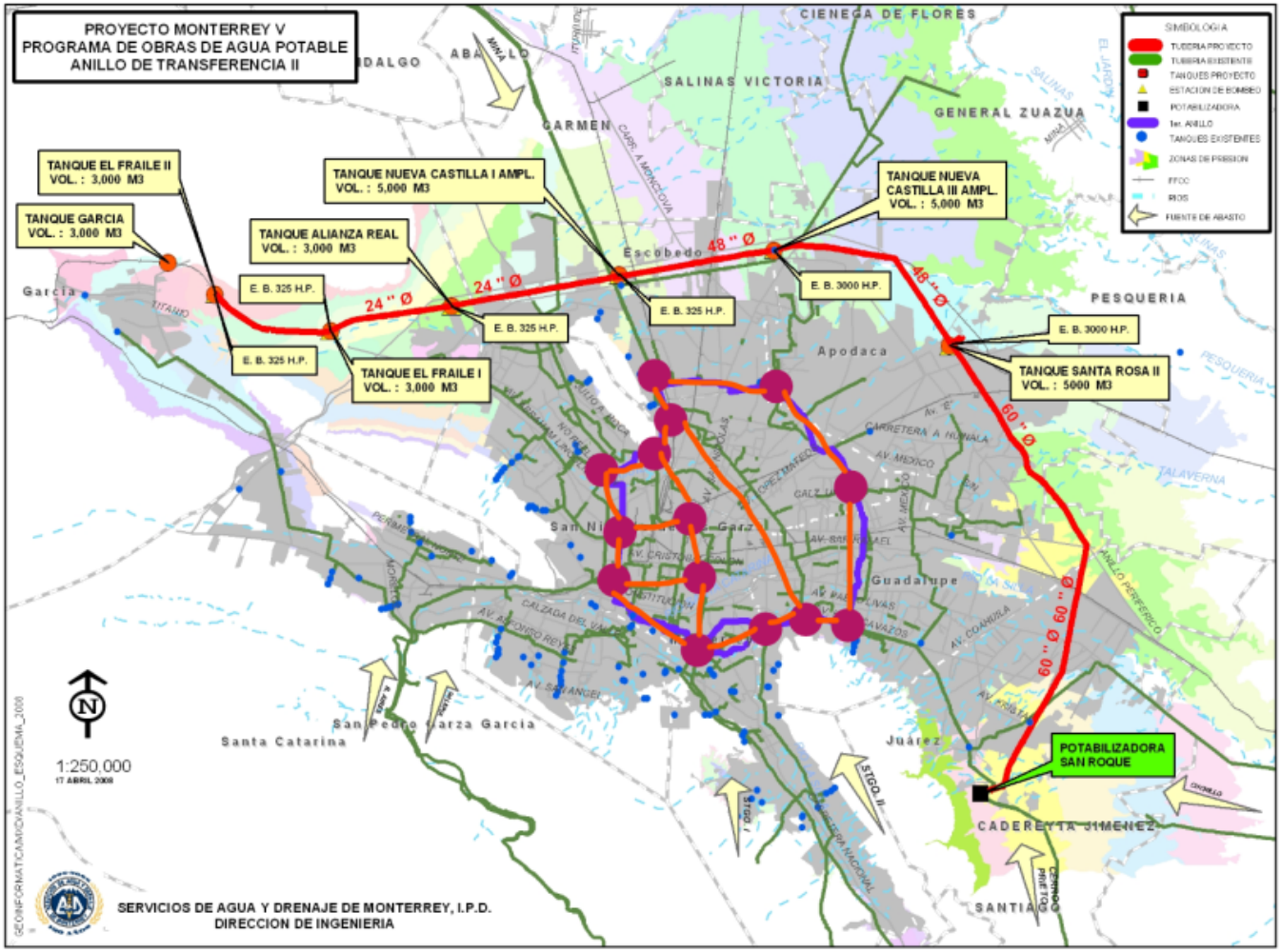
Problem description

Nowadays, water shortage is becoming more common due to climate change. Water resources optimization is necessary to overcome this problem. Quantum computers present a computational advantage when we talk about optimization [1]. Thence, our drive to optimize the network distribution for water supply.



Water distribution system

Monterrey, Mexico (Geographic coordinates)



Objective

Our proposal is to implement, throughout VQA, the optimum water distribution network, taking into account the critical zone in order to simulate the network distribution system for the first ring in the metropolitan area.

This project could be scaled in the future in the early phases of projects planning. Also for local, district zones or any other cities with water scarcity problems.

- To apply sectorization with MAX-CUT
- To optimize the length for the distrubution system

Implementation

The nodes were obtained from pipe nodes coordinates and node edges are the separation between the nodes. For simplicity only one water source (node 0) was taken into account.

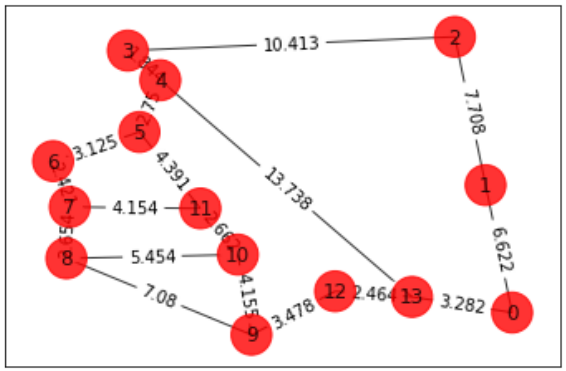


Figura: Original graph. Simplification of the water distribution system of Monterrey, NL, Mexico

Implementation

The first step is sectorization. Sectorization is finding places with similar distribution characteristics. We can think in sectorization as a segmentation or clsterign problem. We used MaxCut to find sectors. Figure (2) shows the results.

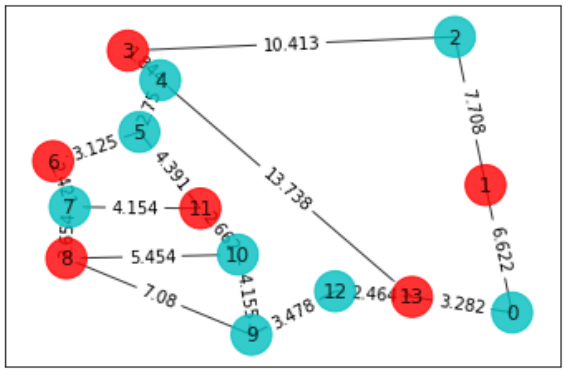


Figura: Results using MaxCut with Qiskit

[1] Velitchko G. Tzatchkov y Victor H. Alcocer-Yamanaka. "Graph theory based single and multiple source water distribution network partitioning". En: *Tecnología y ciencias del agua* 10.6 (nov. de 2019), págs. 197-221. ISSN: 20072422. DOI: 10.24850/j-tyca-2019-06-08.