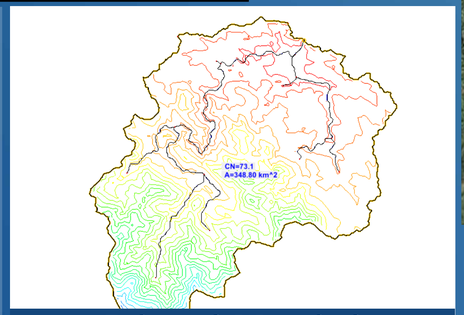
Amina Reservoir Feasibility Analysis

Introduction

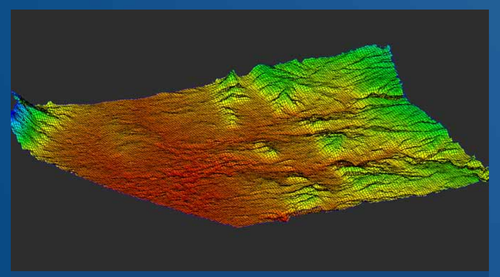
The Dominican Republic's national water agency, Instituto Nacional de Recursos Hidráulicos (INDRHI), has proposed to construct Amina Reservoir for the purposes of drought storage, regulated irrigation supply, flood control, and hydropower for the region. Previous technical reports related to Amina Reservoir were done in 1978 and 2003. Our purpose was to update and reevalutate the project with new data and better technology.

Watershed Characteristics

The tributary area of the proposed reservoir includes both the Amina and Inoa river basins. Using the software WMS and a 30-m digital elevation model (DEM), we delineated the watershed and computed an area of 349 km^2.
According to INDRHI, the average precipitation in our watershed is 1200 mm/yr.



Delinated Watershed



Digital Elevation Model

Irrigation Supply

The reservoir was intended to provide irrigation supply for 2100 ha, and according to INDRHI, a maximum flow of 2.4 m^3/s would be needed for this use. If the regulated outflow is 7.0 m^3/s as suggested, this could irrigate 6,250 ha.

Hydropower

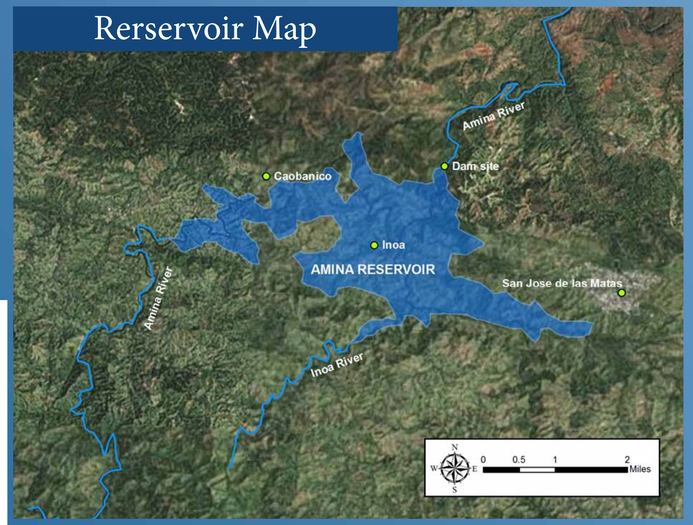
The project will include a hydropower plant with two Francis type turbines that will generate 92.4 GWH per year.

Reservoir and Dam Characteristics

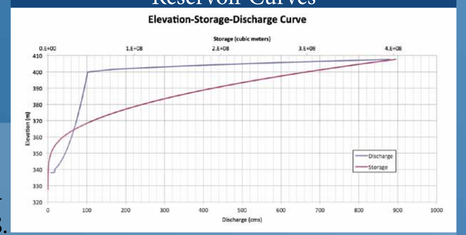
Amina Reservoir will have a useful storage capacity of 337,000,000 m^3. The maximum surface area of the reservoir (at full capacity) will be 14.0 km^2.

The proposed dam is to be situated in a canyon, about 1.5 km downstream from the confluence of the Amina and Inoa rivers, on the north side of the watershed. It is to be a concrete gravity dam with a height of 86.0 m, a crest length of 230 m, and a 60.0-m spillway at an elevation of 400.0 m.

Rerservoir Map



Reservoir Curves

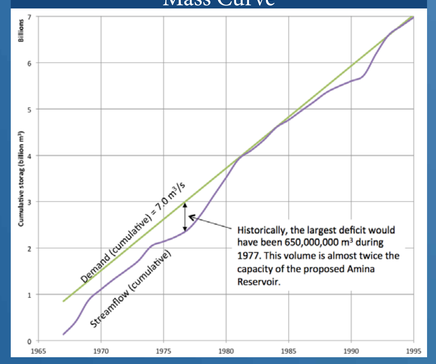


Before routing the flows through the dam to determine the potential hydrograph attenuation, an elevation-storage-discharge curve was developed in WMS. By doing this we were able to determine that the dam has a capacity of about 350 million cubic meters, which if empty, could store the probable maximum flood.

Water Availability & Drought Sotrage

Assuming that the reservoir is full (337,000,000 m3) at the beginning of a drought and that no additional inflows contribute to the reservoir, a regulated outflow of 7.0 m3/s could be maintained for 557 days (1.5 years). After examining the streamflow data, however, we observed that a dry period occurs roughly every decade and lasts for two or three years.

Mass Curve

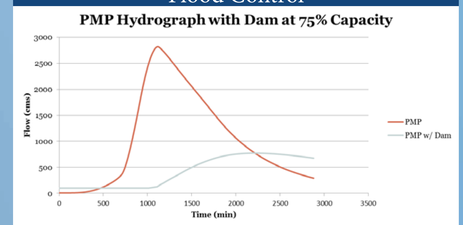


Flood Control

In our analysis we developed models to compare pre- and post-reservoir scenarios, examining the efficacy of the reservoir for flood attenuation and flow routing.

By routing the probably maximum flood through the reservoir at 75% capacity it was determined that proposed dam would significantly attenuate the hydrograph which would decrease the flow from 2800 cms to about 850 cms. This is within the capacity of the outlet works of the proposed dam.

Flood Control

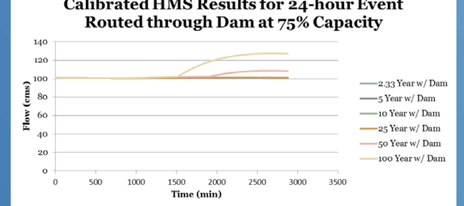


Flood Control and Prevention

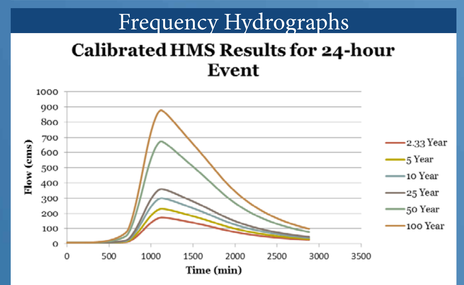
Frequency	Hours needed before storm if drained at 100 cms	Prestorm volume needed (m3)	Prestorm Recommended Elevation (m)
2.33	-8	285,012,280	398.6
5	1	281,653,578	398.2
10	13	277,499,394	397.9
25	22	274,140,691	397.8
50	73	255,844,603	395.8
100	107	243,382,050	395.2
PMP	357	153,356,941	385.0

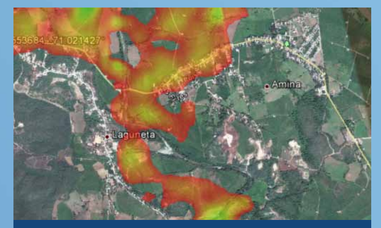
To determine the flood control capabilities of the dam, the HEC-RAS model was developed to show the 100-year flooding with and without the dam. It was determined that with the dam, the downstream flooding would be significantly reduced.
Furthermore, using GSSHA a dam break scenario was modeled. Using the outputs from the model, an animation was developed that showed the flooding effects of the towns downstream of the dam.

Routed Flows



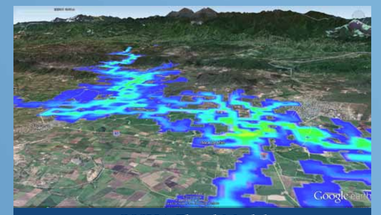
Frequency Hydrographs





HEC-RAS 100 yr Flood Model Without Dam

HEC-RAS 100 yr Flood Model With Dam



GSSHA Flood Model

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