Developing Flow Duration Curves for Use in Hydropower Analysis at Ungaged Sites in Kosrae, Federated States of Micronesia

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The cost and availability of energy resources is one key factor in the economic development and quality of life of any developing country. This is especially true in the Kosrae, Federated States of Micronesia (FSM), where essentially all of the energy produced is from costly, non-renewable, and potentially environmentally damaging fossil fuel (oil) resources. The cost of fuel to operate the local power plant has risen dramatically over the past years and no doubt will continue to rise in the future. With these increases of fuel costs, it becomes more and more important to explore other means of providing energy to the islands power grid.

Kosrae is blessed with an abundance of surface water resources and because of the extreme topography of the island many of these streams have very high slopes. This combination of abundant streamflow and high stream gradient or slope is ideal for the application of run-of-river-hydropower development. This kind of hydropower development has the least environmental impact and is generally less capital intensive than typical hydropower plants built in conjunction with high dams with large amounts of water storage. While in general hydropower plants are high in first cost, the cost per kilowatt hour of energy production is lower than fossil fuel plants and has the advantage of remaining relatively stable over the life of the project.

In order to explore the feasibility of using hydropower as an additional energy source for Kosrae, it is necessary to be able to define the variability of flow available in the streams where the hydropower plants might be constructed. This is normally done by direct analyses of streamflow data for the stream in question or by applying some sort of inferential techniques from a gaged to an ungaged stream or from a gaged location on a steam to an ungaged location on that same stream. What is needed in Kosrae is a better means of predicting the variability of flow at ungaged locations that are likely to become candidate sites for future water resources development.

The results of this project will be the development of a means of predicting flow duration curves at ungaged sites in Kosrae. All of the major streams of the island will be divided into stream reaches, or homogenous sections of a steam, that have similar flow properties. These reaches will be identified on maps developed from the detailed Geographic Information System (GIS) map inventory of Kosrae available at WERI. Various statistical and analytical methods will be applied to the existing streamflow data and physically characteristics of the reaches in order to predict the streamflow in each stream reach.

The final results will be a series of GIS maps of the streams of Kosrae with each stream reach identified. By selecting a reach on the provided GIS maps, the user will be able to obtain the average flow in a reach. Those wishing to explore the feasibility of hydro power at the site will be able to enter the average flow information into a simple spreadsheet application which will be provided as part of the study. This application will allow the user to explore various turbine sizing and economic consideration to determine the preliminary feasibility of developing a hydropower facility at a particular site.