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Modeling of Sediment Transport at Sungai Mersing By Using HEC-RAS

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Abstract: Sungai Mersing is located in the state of Johor, close to the town of Mersing, by follow from the condition of at the place where Mersing got water crisis that being affected by Congok Dam, Mersing that had been very critical because of the lack of the rainfall distribution. The problem really gave the hardness for the people in Mersing to continue their daily routine until they have to limit their usage on water that really important for them. Recent cases due to bad sedimentation can barely impacts to economic and environmental which is loss profit to our country. The river responds by increasing or decreasing sediment carrying capacity, changing the cross section of the channel, erosion and deposition along the channel, all of which have an impact to on river bank stability over time. This research is to model on the sediment transport at Sungai Mersing using Hydrologic Engineering Center River Analysis System (Hec Ras) for analysis more detail in analysis the river. There is a few data that required to gain all the analysis on sediment transport which are catchment area, precipitation data, geometric data and sediment data. The analysis that had been made can be done using various way of transport function in the Hec-Ras can be done using various way of transport function in the software. This also to control and predicting the river behavior. In general, by applied the HEC-RAS software on modelling of sediment transport it can determine the characteristic of Mersing river.

Keywords: Sediment Transport, HEC-RAS Software,

1. Introduction

Sedimentation is the process where it separating the small particles and sediments in water. This type of process occur naturally when the water is till, because the gravity can draw down the heavier sediment where it can create a sludge layer. For the water treatment process, this action may be artificially induced. Thickening is the name of this mechanical assistance. Sedimentation process is

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assigned to decrease particle concentration in the water. Most of the earth organisms get the source from the river which is the habitat and also the food. This is because various type of plant and trees grows by the rivers and it also very useful for the other habitat such as animals. Animals also make rivers as a place for them to stay and to them to search for food and drink. Other than that, river also can be use a medium for transportation which it provide the routes to be used for the people for exploration, commerce and recreation. Recent cases due to bad sedimentation can barely impacts to economic and environmental which is loss profit to our country. This is because, plant growth have the ability to control the erosion process. River and beaches that are sediment are also poor for recreation and tourism when the aesthetic performance of river are diminished and activities such as swimming and kayaking are impacted. As I can say, sedimentation of rivers has become a serious economic implications as river sections and structures such as the culverts are obstructed and the river floods nearby during the heavy flows. So throughout this research, with advance technologies sediment transport have been added to the Hydrologic Engineering Center's River Analysis System which can be shortform as HEC-RAS software. By using this software, it is easier to perform and Calculations for movable beds and sediment routing.

So as day by days keep counting, our technology become more advance in every single things including in this river engineering field where it can controlling and predicting the river behaviour. This is for sure in improving the river system to become better and prevent from the hydraulic issues. The HEC-RAS software can offer information on sediment movement within the hydrodynamic system, such as concentrations of suspended silt, sediment erosion and deposition rates, as well as sediment transport channels.

The aim of this research is to find out more about the flow of the water supply on river water by using sediment transport and apply it into the HECRAS. The main objective are as follows with to analysis the characteristics of sediment transport at Sungai Mersing and to identify total load of sediment transport at Sungai Mersing.

1.2 Sediment Transport Modelling

There are approaches for modelling sediment transport that aim to provide information on sediment flow within hydrodynamic systems such as estuaries. The sediment transport model produces estimates of suspended sediment concentrations, sediment transport speeds, sediment erosion and deposition, and sediment transport pathways, among other things. The majority of sediment transport is dependent on hydrodynamic model output or both, which can also relate the sediment equation at each model simulation time step. In these circumstances, numerical solutions of tidal, discharged, wave, and meteorological forces are employed to predict water level and currents in the equation representing sediment transport. Because of the wide range of sediment types, sizes, and transport mechanisms that occur within an estuary, a number of mathematical equations are needed to mimic the sedimentary processes that occur in estuarine environments [1][2].

A variety of sediment transport models have shown that the correct sediment distribution can only be achieved if the salinity, river discharges tidal flow, terrain and intertidally, the presence of plants are all present. As a result, it is critical to examine the circulation within a specific estuary when determining the estuarine circulation pattern in order to ensure that the right method is represented in the sediment model.

Predicting sediment and pollutant movement in surface water systems requires a thorough understanding of sediment motion. This seminal work that conducted by Van Rijn had discuss about the impact of bed shape on non-cohesive sediment transport and the mechanisms of bed load, suspended load and bed form.

2. Materials and Methods

2.1 Study area

This research took place in Sungai Mersing, Mersing, Johor, Malaysia. The stream is linked with many sub-stream and connected to the downstream at the nearby river. Sungai Mersing also is a well

known as fish landing area since it depends on fisheries sector. This is one of the reason we have to take care of Sungai Mersing. From the sedimentation process to make sure it in a good way so that they can run their business at this area. We can say that the development of tourism industry at this area is increasing. The figure 1 show the location site of sediment transport modelling.

Figure 1: Site Location

2.2 Methods

Secondary data is information that has been taken from other organization in order to perform the thesis. In this cases, the data obtain from the previous study and researches for the bed gradation and flow data at Sungai Mersing.

The bed gradation data was shown in the table that collected in previous study of Sungai Mersing. The data were computed in Hec-ras to stimulate the sediment transport modelling.

Table 1: Bed Gradation of Mersing River

	Class	Diameter	%Finer
1	Clay	0.004	0
2	VFM	0.008	0.01
3	TM	0.016	0.02
4	MM	0.032	0.03
5	CM	0.0625	0.07
6	VFS	0.125	0.15
7	FS	0.25	0.81
8	MS	0.5	4.68
9	CS	1	56.12
10	VCS	2	92.69

While for the flow specification for sediment transport computations currently follow the quasi unsteady flow approach. Table 2 show the data of flow for Sungai Mersing.

Table 2: Data of Mersing River Flow

No.	Flow Duration (Hour)	Flow (m^3/s)
1	2	35.91
2	2	33.09
3	2	30.81
4	2	26.71
5	2	34.74
6	2	29.91
7	2	26.34
8	2	23.57
9	2	35.26
10	2	31.56
11	2	36.43
12	2	33.45
14	2	14.17
15	2	13.78
16	2	12.41
17	2	12.81
18	2	11.25
19	2	10.34
20	2	13.31

For this one, the data that we get is from the schematic data that we make in the Arcgis Software and will be converted into the Hec-ras software to perform it. Using the Hec- ras software to model sediment movement, it is to developed sediment analysis from quasi-unsteady flow. The simulation's result is determined by post-processing the acquired data by running the model and visualising the results.

3. Results and Discussion

This chapter will discuss and present the result from the Hydrology Engineering Center-River Analysis System (Hec-Ras) to perform the sediment transport modelling at Sungai Mersing, Johor. For determine the characteristic of Sungai Mersing, 5 points have be plot down on the Arcgis Software to get the data and information of this river. By editing the river, banks, flowpath and XS cut line, the geometry data to proceed on modelling the sediment transport can be done.

3.2 Output of HEC-RAS Results

Results can be presented in the form of tables, figures, charts, diagrams or other suitable formats. Hydrologic Engineering Center River Analysis System (Hec-Ras) can be used for sediment transport in order to perform the sediment routing and mobile bed computation. From the data and information from ArcGIS that ahd been created by following DEM of Sungai Mersing, the general schematic data had been done.

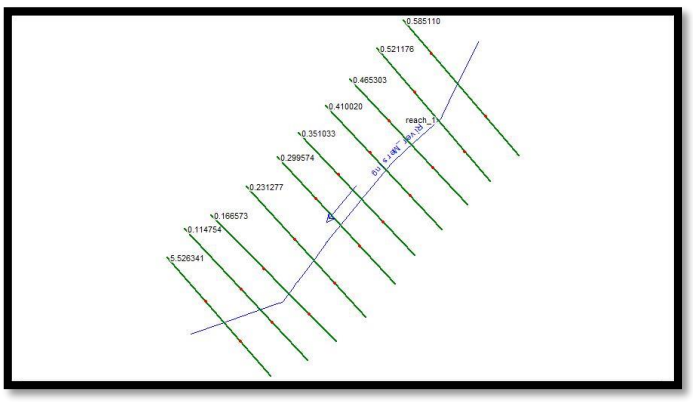

Figure 3: Schematic plan for the river.

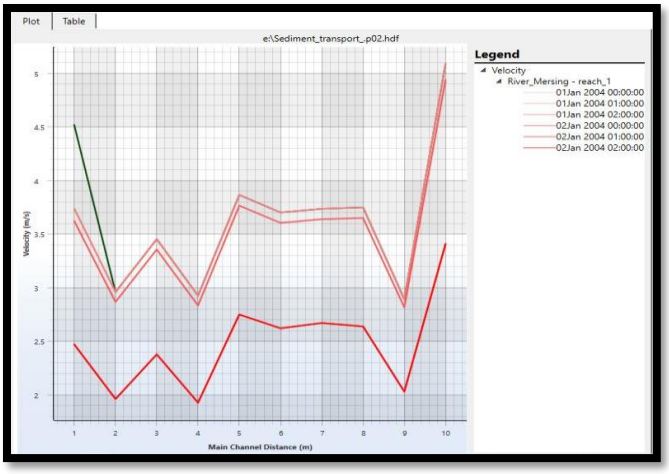

Figure 4: Flow Characteristic of Sungai Mersing

From the Figure 4, it is shown the variation of velocity flow at Sungai Mersing at each point. At certain point the maximum can be reached it too 5.20 m/sec and the minimum velocity can be reached to 1.80 m/sec. So there is a large fluctuation in velocity along Sungai Mersing. At higher, it seemed that the erosion can happen too.

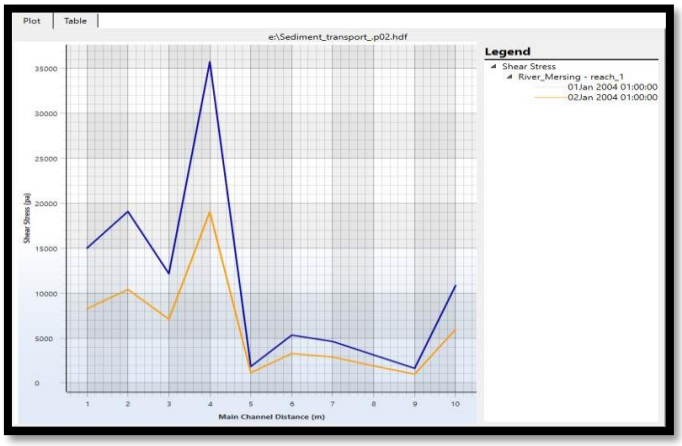

Figure 5: Shear Stress of Sungai Mersing

From the Figure 5, the shear stress of Sungai Mersing can describe the bed laod movement and sediment transport. It is shown that shear stress can go to 36000 pa at certain point of Sungai Mersing . This number can prove that Sungai Mersing can be classified as fast river so that it can moves more sediment from this point. The erosion still happen along the stream.

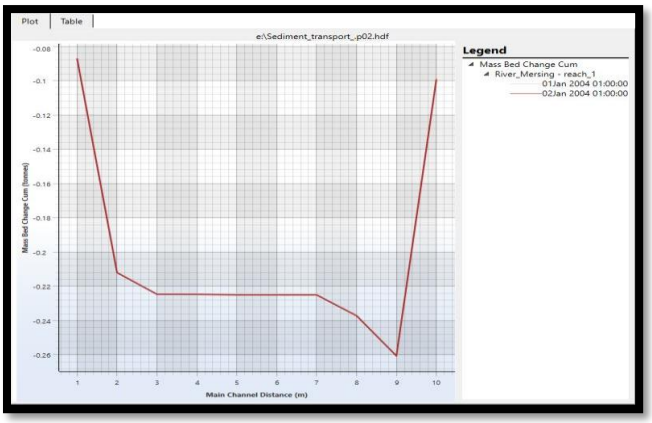

Figure 6: Mass bed change of Sungai Mersing

It is shown from the Figure 6, that the mass bed change can be minimum until it reaches to -0.26 tonnes. For the maximum point it shown – 01.6 at the start of the flow. So, between this point it occur the erosion and sedimentation depend on mass bed change whether the sediment can move or stop in at the certain area.

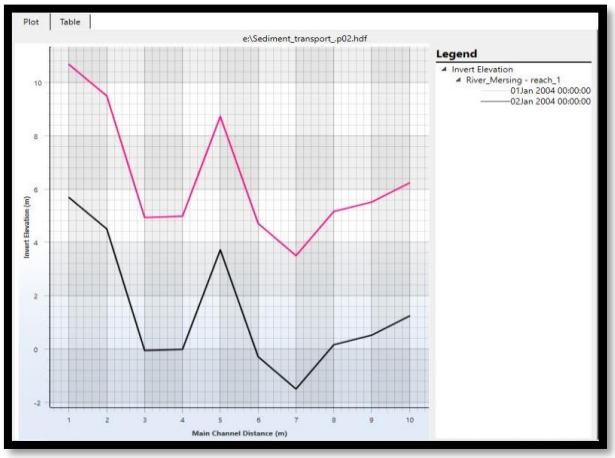

Figure 7: The elevation of Sungai Mersing

The elevation from the Figure 7 can be reaches to maximum 10.6 meter at the first point and the minimum can reaches till -1.5meter at another point from the graph. The different of elevation can be due to the different temperature during day and night.

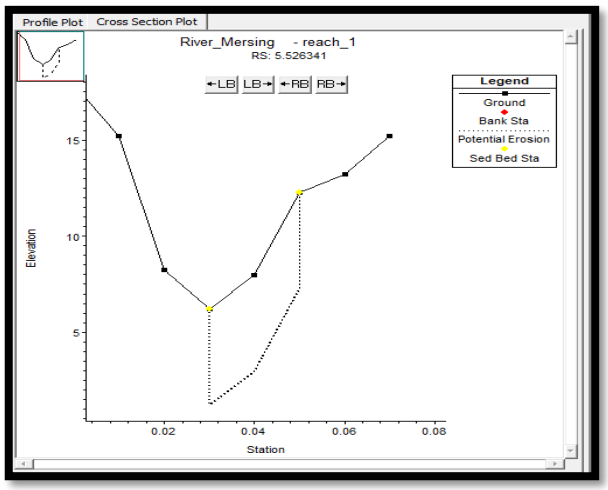

Figure 8: Sediment Data of Sungai Mersing

At the dotted lines we can see in Figure 8, there might be the erosion to occur at the point between the station 0.02 – 0.06. So at that point it will be the evolution of the landscape at that place and also the loss of the agricultural soils. This is driven from the stream hydraulics of this river.

4. Conclusion and Recommendation

4.1 Conclusion

In the result that we get, the creation of long-term sediment disposal plans can be also look within the actual environment and economic consideration at the Sungai Mersing is necessary so that it will not harm the habitat at the area. In addition, the first objective was to determine the characteristic of Mersing River flow and the second objective is to simulate the sediment transport in Mersing River by using Hec-ras. From the result, it show that the variation of velocity at Mersing River which the maximum can be reaches to 5.20 m/sec and the minimum velocity is 1.80 m/sec. Other than that, it also show that the elevation of this river can be change due to the different temperature during day and night.

4.2 Recommendation

This chapter presented the recommendation related to the findings of the study so it will discuss the recommendation based on the findings of the study which are:

- A research program that related toward this sediment transport should be established in order to have a better understanding of the estuarial sediment transport mechanism.
- the agency that related with the development on the city should begin developing on the long-term strategies for all coastal and estuarine navigation facilities in the area have dredged material management
- Create an awareness to the citizen at the area to take a good care of their river because this sediment transport is also a where ecosystem can get benefit whether it direct or indirectly

Acknowledgement

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