Step by Step Guide to Hydrological Estimation

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Introduction:

Research by Ilhardt *et al.* (2000) determined the 50-year floodplain was the optimal hydrologic descriptor of a riparian ecotone along a moving watercourse. This flood recurrence interval was selected because the 50-year flood elevation, in most cases, intersects the first terrace or other upward sloping surface and supports the same microclimate and geomorphology as the stream channel. The 50-year flood plain also coincides with measurements that quantify a valley to its stream via two measurements: the entrenchment ratio (valley width at the first terrace or up slope to the stream width at full bank); and the belt width ratio visible on aerial photos or maps.

Before running the model, a determination of an appropriate 50-year flood height is necessary and is a critical input into the model. Mason (2007) explained the hydrological estimation of the 50 year flood height in a simple straight forward method and is illustrated below. The calculations are derived from Bedient and Huber (2002).

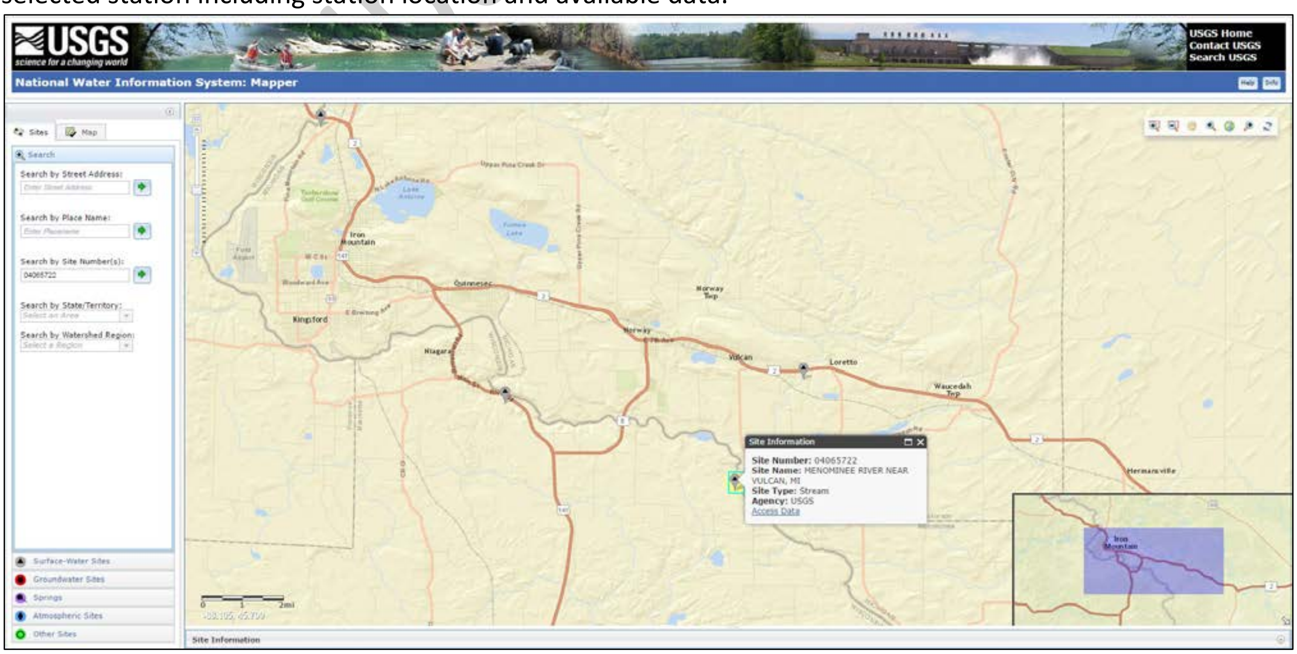
Basic Information:

- Locate all gauging stations within or in close proximity of your study area using HUC-6, 8, 10, or 12 digits layer as a reference.
- Download required data (Annual Statistics and Field Measurements data) per each gauge.
- Calculate 50-year flood height per each gauge utilizing the 50-year flood height calculations below.

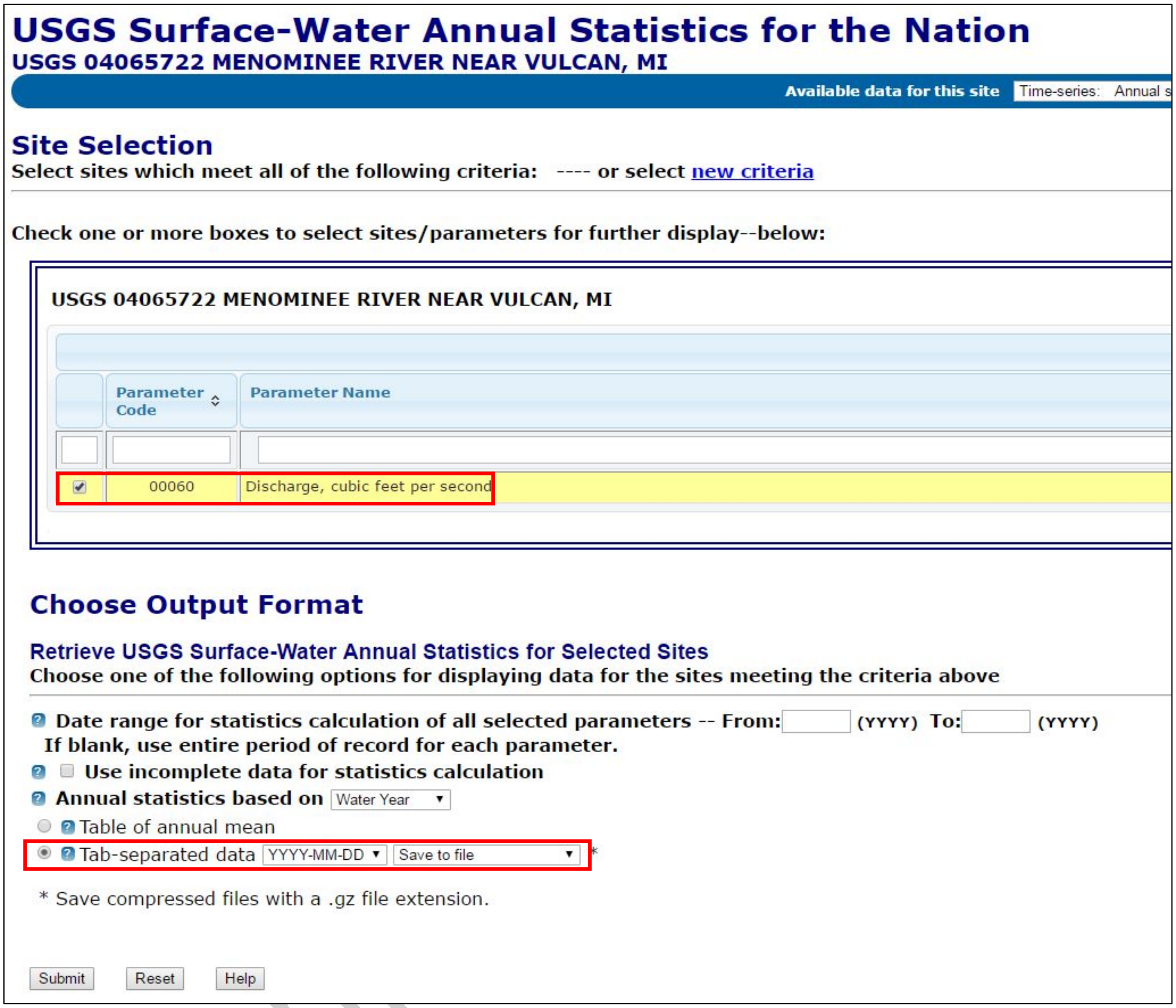
50-Year Flood Height Calculations:

A sample calculation of 50-year flood height for gauging station 04065722 is presented below.

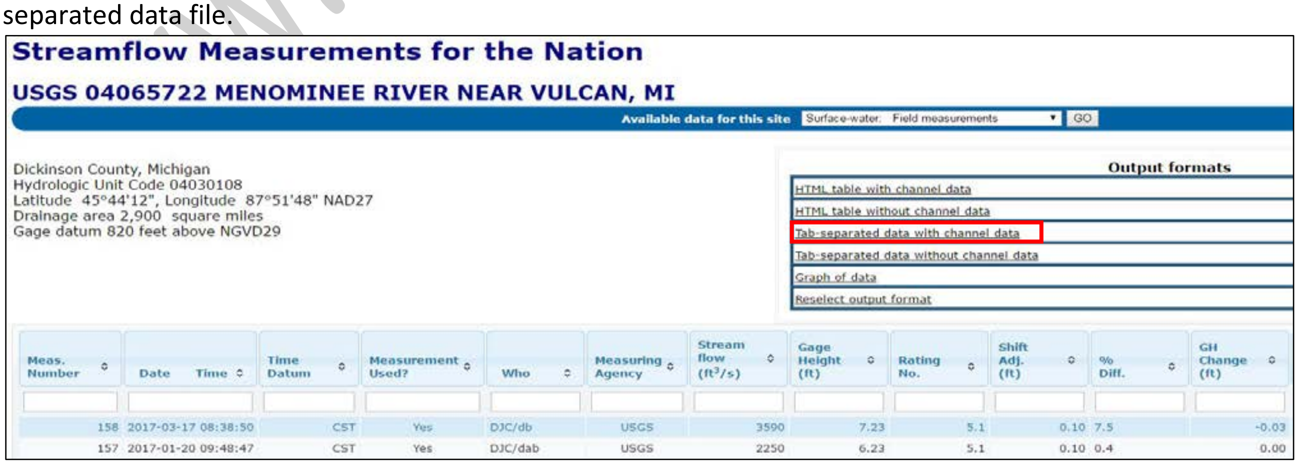
1. Go to USGS Water Data for the Nation https://waterdata.usgs.gov/nwis.
2. Click on the map viewer.
3. Locate USGS gauge station 04065722 using “Search by Site Number(s)”
4. Click on the gauging station of interest and a new page will open with station information including its gauge number (a unique identifier).
5. Click “Access Data” to access the gauging station website which contains a complete description of the selected station including station location and available data.



6. Select “Annual Statistics” which includes the annual average discharge (ft3/sec.) rate. Save to a Tab-separated data file.

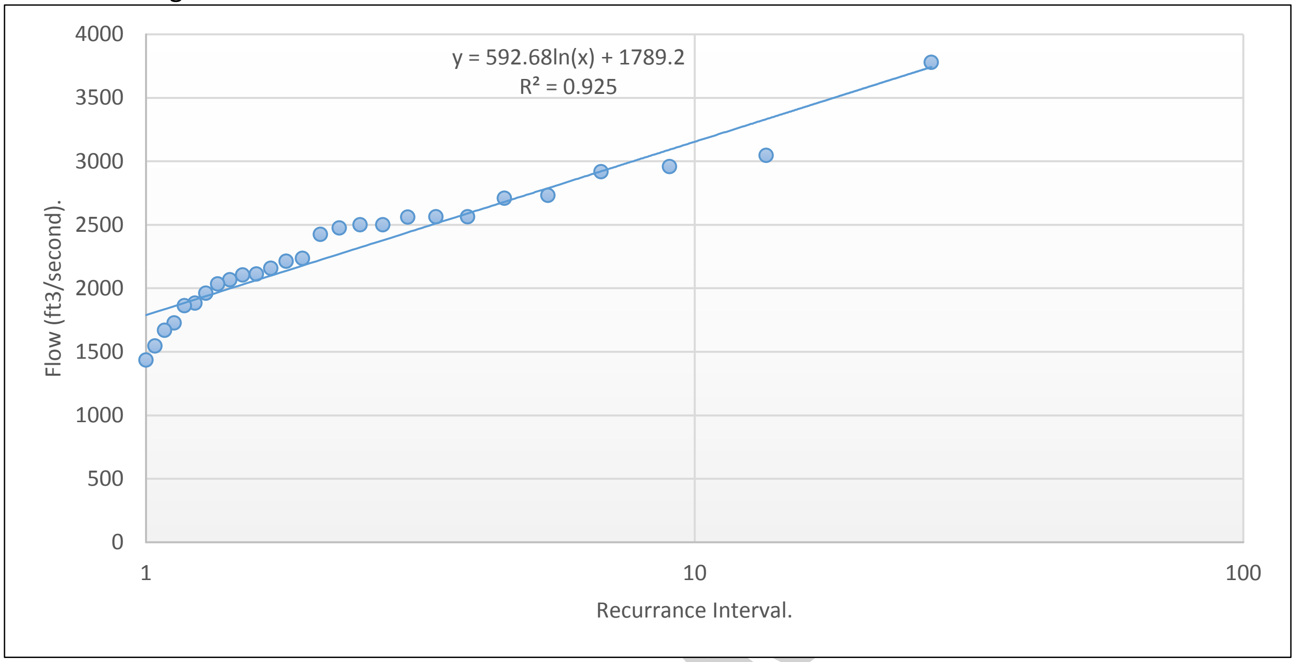


7. Next, select “Field Measurements. The output format must include channel data. This provides periodic measurements of channel flow (ft3/sec), channel width (ft.) and channel velocity (ft/sec). Save to a Tab-separated data file.

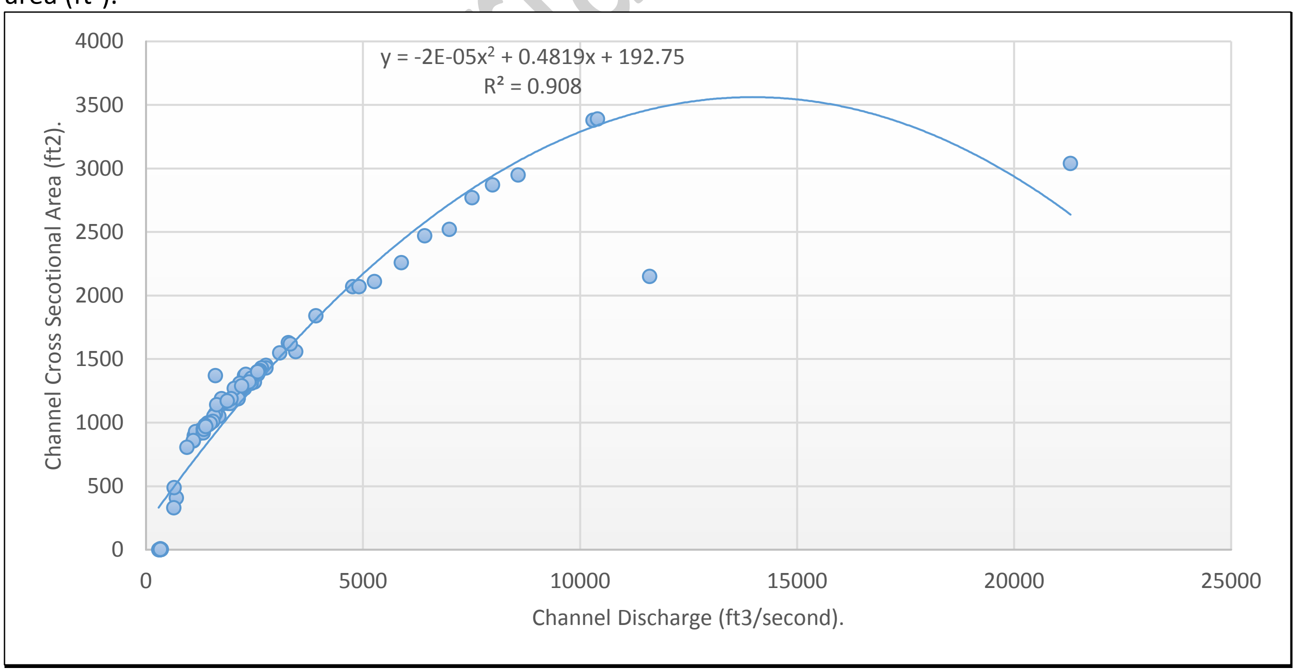


8. Use the “Hydrologic_Estimation” Excel file to complete the calculations.
9. Copy “Annual Statistics” data into “Hydrologic_Estimation” Excel file. Paste Special (values) the data into “Year” and “Annual Flow (ft3/s)” columns (green area).

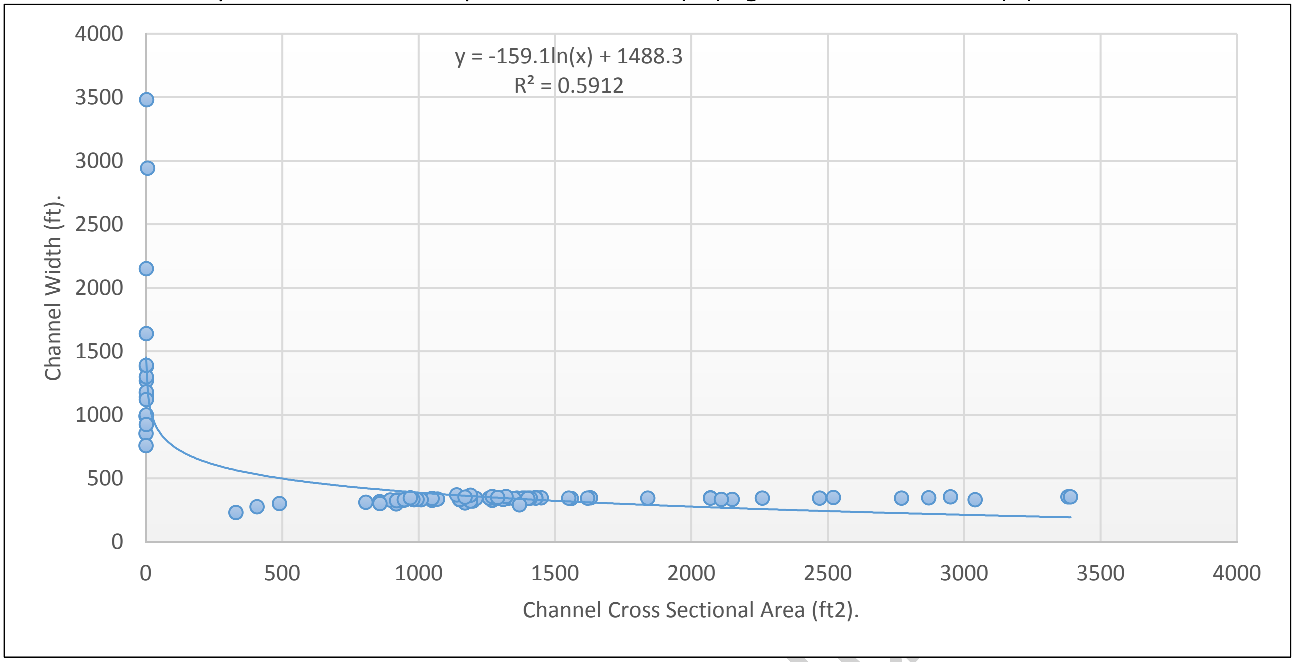
10. Click “Calculate Equation-1” button to rank the measurements so the fastest flow rate receives a value of 1 then calculates the recurrence interval by dividing the rank number by the number of measurements. Plot the flow rate against the logarithmic recurrence interval years to develop a flood occurrence regression as illustrated below.



11. Copy data from “measurements” file to “Field Measurements” section within “Hydrologic_Estimation” Excel file (red area). Use Paste Special (Value). Remove entire row if it contains text, special characters, or zeros.
12. Click “Calculate Equarion-2” button to plot channel flow (ft^3/sec) against the channel cross sectional area (ft^2).



13. Clikc “Calculate Equation-3” button to plot channel area (ft^2) against channel width (ft).



14. Type the coefficients for each equation as illustrated.

Mason 2007 Claculations	Coefficients		
Equation-1	c	b	
y = 592.68ln(x) + 1789.2 R² = 0.925	592.68	1789.2	
Equation-2	c2	c1	b
y = -2E-05x2 + 0.4819x + 192.75 R² = 0.908	0.00002	0.4819	192.75
Equation-3	c	b	
y = -159.1ln(x) + 1488.3 R² = 0.5912	-159.1	1488.3	

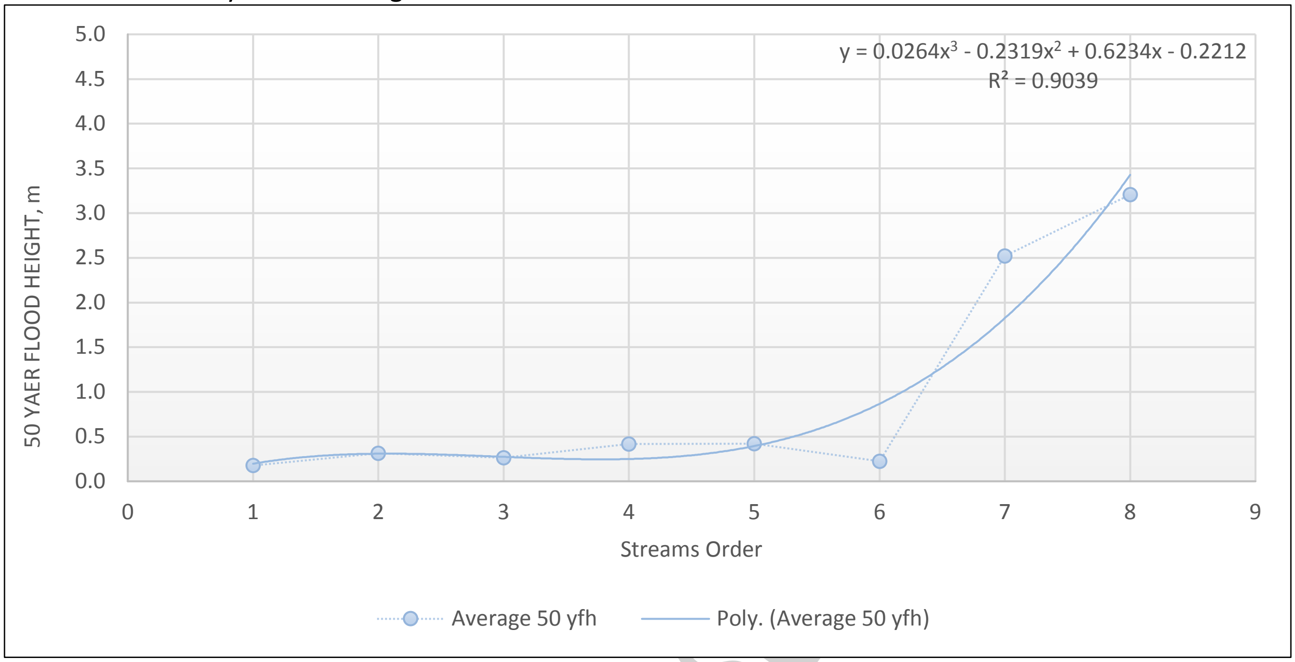
15. The 50-year flood height will be calculated automatically. Year one is calculated as a reference.

	1	50	100
	1789.2	4107.777795	8239.570497
b 192.75	1118.990213	2509.764888	34305738.74
	371.3890499	242.8740527	25823.23018
Flood Height (ft)	3.01	10.33	1328.48
Flood Height (meter)	0.92	3.15	404.92

16. Repeat the same steps for other gauges.

50-Year Flood Height vs. Stream order:

1. Locate each gauge to its stream order using ArcGIS.
2. Plot calculated 50-year flood height vs. identified streams order as illustrated.



3. Estimeate 50-year flood height values from the polynomial equation for streams order without gauges.
4. Create a new field such as “FloodData” inside streams layer attributte table. The new field should have a “float or double” field type.
5. Populate “FloodData” field with 50-year flood height values for each stream order as illusterated. the streams attribute table should look like below.

ReachCode	FType	FCode	Shape_Length	StreamLeve	FloodData
04070007003930	558	55800	458.908594	3	0.75
04070007003931	558	55800	175.620519	3	0.75
04070007002087	558	55800	168.879008	4	1.5
04070007003932	558	55800	554.993633	3	0.75
04070007002087	460	46006	145.739779	4	1.5
04070007002087	460	46006	247.083598	4	1.5
04070007002087	460	46006	214.626639	4	1.5
04070007000565	460	46006	1479.038735	3	1
04070007000567	460	46006	2127.016664	3	1
04070007000087	558	55800	4673.628436	2	0.5
04070007000121	558	55800	17.983603	2	0.5
04070007000166	558	55800	21.867946	3	0.75
04070007000565	558	55800	10.323687	3	0.75
04070007000086	558	55800	5830.316587	2	0.5