Written Report in Stream Gauging II

(Field work at Arayat River, October 2013)

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Introduction

Typhoons are the biggest risks in the Philippines.

One of the Primary effects of this calamity is River flooding. It occurs when the flow rate exceeds the capacity of the river channel, particularly at bends or meanders in the waterway. It often causes damage to homes and businesses if they are in the natural flood plains of rivers. While riverine flood damage can be eliminated by moving away from rivers and other bodies of water, people who have traditionally lived and worked by rivers because the land is usually flat and fertile and because rivers provide easy travel and access to commerce and industry.

This effect is evidential during Tropical Storm Thelma (Uring) which battered in Ormoc City in 1991. It caused floods that killed thousands of people. According to reports, much of the Visayas received 150 mm (6 in) of rain; however, on Leyte Island there was a localized downpour that brought totals to 580.5 mm (22.85 in). With the majority of this falling in a three-hour span, an unprecedented flash flood took place on the island. Much of the land had been deforested or poorly cultivated and was unable to absorb most of the rain, creating a large runoff. **This water overwhelmed the Anilao–Malbasag watershed and rushed downstream. Ormoc City, located past where the Anilao and Malbasag rivers converge, suffered the brunt of the flood. In just three hours, the city was devastated with thousands of homes damaged or destroyed.**

This is the reason why one of the main tasks of each hydrologist is to work on fields.

In general, Streams/rivers are the usual target of study of hydrologists. When working on field, parameters like, depth, width, velocity, area and elevations at one chosen cross section/s are recorded using digitized devices. The data are used for acquiring levels of water and the amount of discharge at specific points in time and location, which will further lead to getting reliable and accurate measures for giving flood warnings during rainy seasons and typhoons especially in communities living near the banks of the rivers.

It is at the core of the task wherein hydrologists make theories into practice, lectures into hands-on examples, formulas into functions, estimations into real numbers.

And most importantly, this is the way they make knowledge of the world be their defense to save lives.

Description of the site:

In particular, Arayat river in Pampanga province had been the target area of study of a two-week field work done by the class, from October 17-18 and 21-22, 2013.

The weather condition for the entire four days is mainly sunny, and the water generally flows at a slow movement.

It has its banks which are mostly covered with mud and grasses. The left water edge is elevated at 3.809 m and 5.131 m in the right water edge.

The river is associated with a Bridge named San Agustin Bridge with a length of 247 m . The elevation of the railing from mean sea level is approximately 16.031m. Along with it is the Arayat rainfall & river gauge station.

The flow of the river is slightly affected by weeds near the banks and waterlilies at the middle portion of the river. The highest flood water mark in the river is computed to have an elevation of 7.822 m in the right bank and 3.848 m in the left bank.

Objectives:

This paper aims to tackle the reports on:

a. **detailed procedures** in Method 1 (Current Meter), Method 2 (Acoustic Doppler Current Profiler), Method 3 (Float Method), Method 4 (Slope-Area) and Method 5 (Rope-Weight Method)
b. **compilation and manipulation** of data gathered to compute for the discharge measurement and to arrive at a rating curve and rating curve equation
c. **analysis associated to limitations of the methods during the fieldwork**, specifically the effect of variations, discrepancy, contradictions and consistency of data.
d. **summary and conclusion of results**.

Method 1
Current Meter (Boat Method)

Price AA Current Meter as a tool to measure Depth and Velocity of a river.
Tag line as a tool to measure Horizontal Distance

Procedure:

1. Set up and calibrate current meter and test necessary device such as the beeper and sounding reel if it is functioning at a certain depth before boarding it on boat. The calibration equation used is:

$$V = 0.702N + 0.013$$

(This is very important especially if the current meter has been used many times so as to avoid problems before or during the operation just like what happened in this case:

The sounding reel did not work due to an incorrect direction of rolls.

2. Measure a correction distance from the boat to the water surface to avoid records of incorrect depth. In this case, 0.3 meters was recorded.
3. Record the starting time.

4. The first vertical in the cross section is 1 meter from water edge of the right bank into which the depth was measured through the sounding reel.

(in this point, there was no data recorded for the number of revolutions since the current meter cannot recognize the relatively slow movement of water. The beeper of the current meter beeps only after 5 rotations.)

5. The second vertical is 3 meters away from the first 1 meter, trying to measure velocity at 0.6 depth through the beeper.

(deciding how many point measurements to be done depends on the flow and level of water. In this case, only one point measurement was done since this method was conducted at the last day of the field work having a significant loss in water compared to the first day. In the bridge method, which was done on the first days, 0.2 and 0.8 points were also measured, together with the vertical angle from the bridge to the sounding reel)

6. The rest of the verticals in the cross section were chosen on a different interval, mostly 5 meters away from the previous vertical, depending on the presence of obstruction, until the water edge in the left bank is reached. The verticals follow the same procedure and acquired different values for depth and velocity.

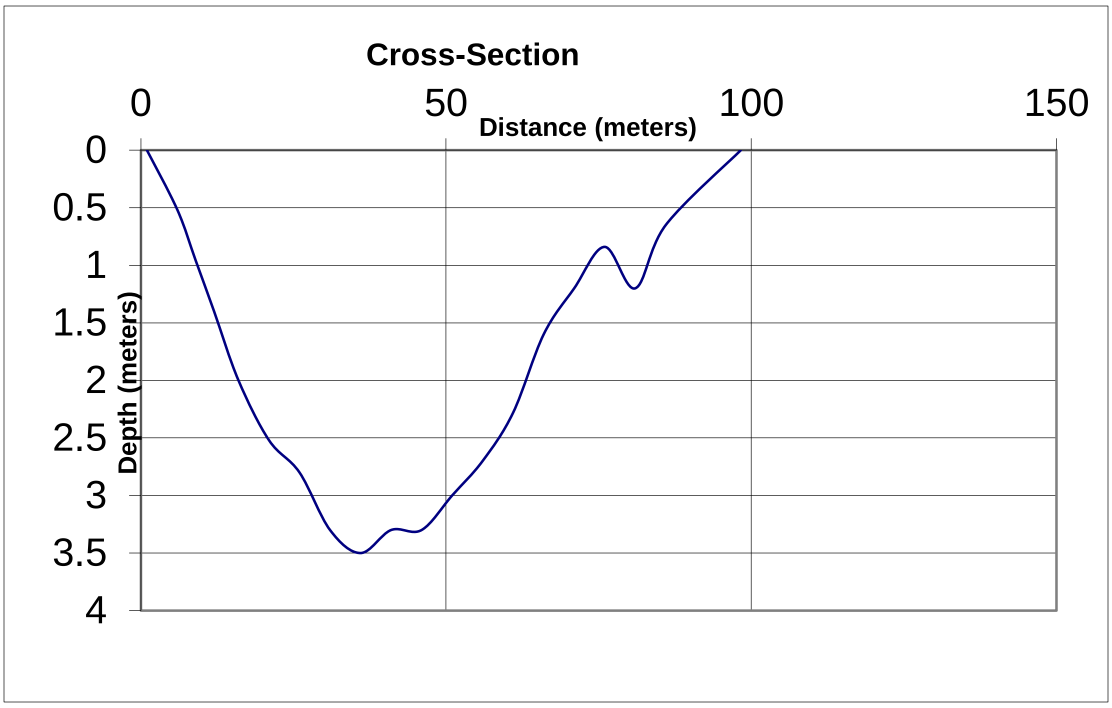
7.Record finishing time.

The summary of data is as follows:

Station	Distance from Left Water Edge (m)	Water Surface Depth (m)	0.6 Depth (m)	Velocity	
				No. of Revolutions	Time (sec)
1	1	NA	NA	Unable	60
2	6	1	0.4	Unable	60
3	9	2.1	0.84	Unable	60
4	12	3.17	1.268	Unable	60
5	16	4.7	1.88	1	60
6	21	6	2.4	6	61
7	26	6.8	2.72	10	61
8	31	8.1	3.24	10	61
9	36	8.6	3.44	13	62
10	41	8.11	3.244	8	63
11	46	8.05	3.22	5	65
12	51	7.4	2.96	9	75
13	56	6.5	2.6	5	30
14	61	5.42	2.168	1	45
15	66	3.62	1.448	7	66
16	71	2.75	1.1	Unable	60
17	76	1.8	0.72	Unable	75
18	81	0.9	0.36	NA	NA
19	86	0.35	0.14	NA	NA
20	98.3	NA	NA	NA	NA

Total Discharge: 13.86 m^3/s

The Graph is shown below:



Analysis associated to the limitations of the method during the field work: (issues and concerns)

One point measurement such as 0.6 measurement is done usually during low flows. This is due to the fact that the three point measurements (0.2, 0.6, 0.8) can only be attained in high flows. In most cases, especially in using a 0.8 point measuremen , velocity decreases with the increase in depth due to the effect of weeds and boulders beneath the river. In the table, it is quite noticeable that the deeper part of the river is mostly concentrated on the left bank, corresponding to a varying velocity. This varying velocity in this case is due to a non-free flow of water brought about by closing of a nearby dam at that same day.

There were no Vertical Angles recorded since the method was done on a boat, providing only negligible difference in location of the submerged current meter from the actual distance of the boat. (on the excel, it is not preferable to input a 0 angle because the program misinterprets the data.) The first 4 verticals didn't have a recorded number of revolutions due to a relatively low water level and a slow movement of the current near the banks and mostly because of the water lilies and grasses floating near banks.

Distances 31, 41 and 46 from initial point show almost the same values of depth but different values of velocity. This indicates that the chosen cross section contains a number of obstructions both on the surface and beneath the water, which caused the variations in velocity at the said depths.

In the summary of data, the computed area in excel is basically based on the formula of getting a rectangular area, that is, width x depth. The discrepancy lies on the fact that the dimensions covered in each vertical don't follow a strict rectangular shape. The computed area might be greater or less than the actual area of the vertical. Thus, it must be taken note that the discharge measured (13.86 m^3/s) is not that reliable and accurate but just an estimation of the actual discharge.

Lastly, the current meter used is not calibrated well before it functioned. The outcomes of the number of revolutions might be of slight error.

These irregularities of data can be minimized by further repetition of processes and by getting the average of the results; In this way, one can have a more valid and valuable data to serve as basis of making flood forecasts in the future.

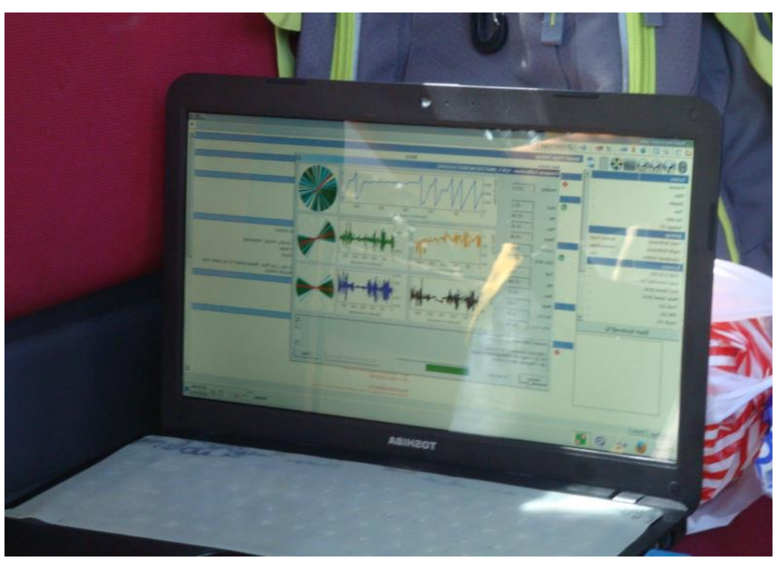
Method 2
Acoustic Doppler Current Profiler (boat Method)

ADCP as a tool to measure velocity and depth of a river
Radio as a tool for communication
Software as a tool to record data sensed by the ADCP

Procedure:

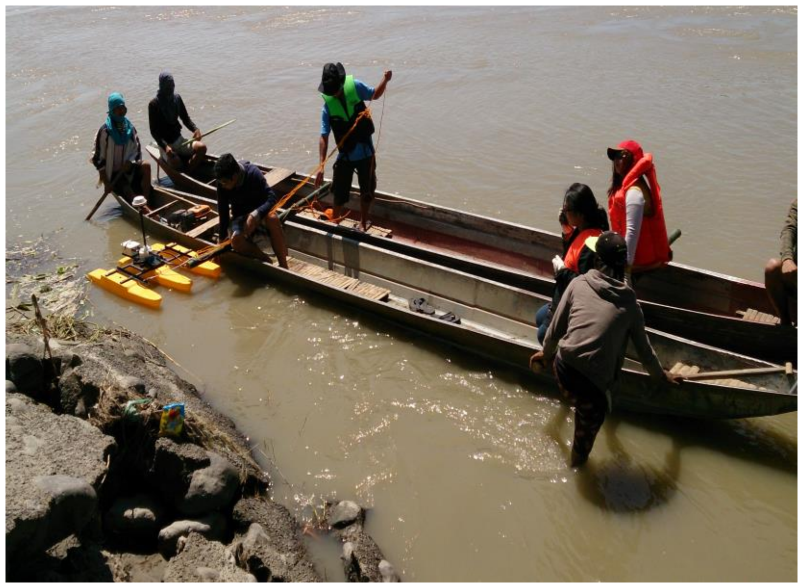
1. Set up ADCP, test necessary device such as the radio, and connect necessary wirings.


2. Calibrate the device by moving it back and forth while rotating, check if the software responds to the calibration and wait until the software indicates a successful calibration.



3. Carefully place the device on the river, and record the starting time.

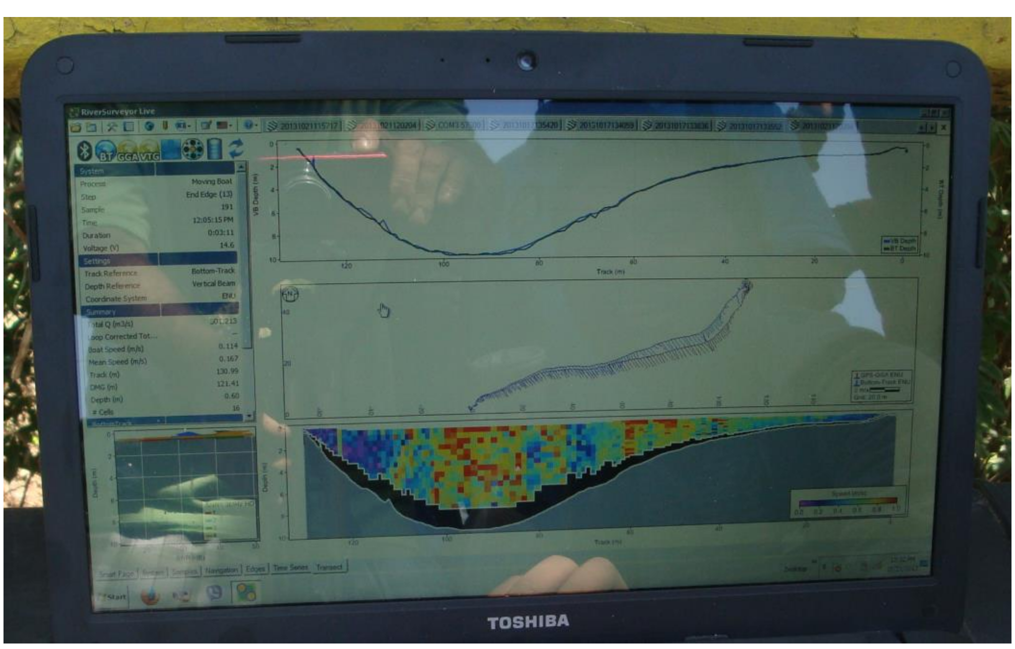
4. Let a boat drive it to several transects. Start and end recording at least 0.5 meter away from water edge so that the device could have a full access from bank to bank. The radio speaker on the boat should communicate with the radio speaker in charge to operate the software when and at what point to start/end recording.



5. Cover as many transects as possible, in this case, 8 transects (back and forth were covered)
6. Record Finishing time.
7. Carefully bring back the device to the station.

The summary of Data is as follows:

Transect	Discharge (Q in cms)
1	292.871
2	292.668
3	304.15
4	334.503
5	250.691
6	238.568
7	296.384
8	301.213
Average	**288.881**



Advantages and limitations of the method during the field work:

Unlike Other methods, ADCP has a fast and easy way of discharge measurement. It attempts to measure water current velocities over a depth range using the Doppler effect of sound waves scattered back from particles within the water column. If the water is very clear, the device may not hit enough particles to produce reliable data. Also, bubbles from turbulent water or schools of swimming marine life can cause the instrument to miscalculate the current. In connection to this, it is also important to keep the transducers from growing algae and barnacles.

With appropriate calibration, a single instrument is enough to cover up to 1000 m of water column, this allows more accurate estimations of flow patterns.

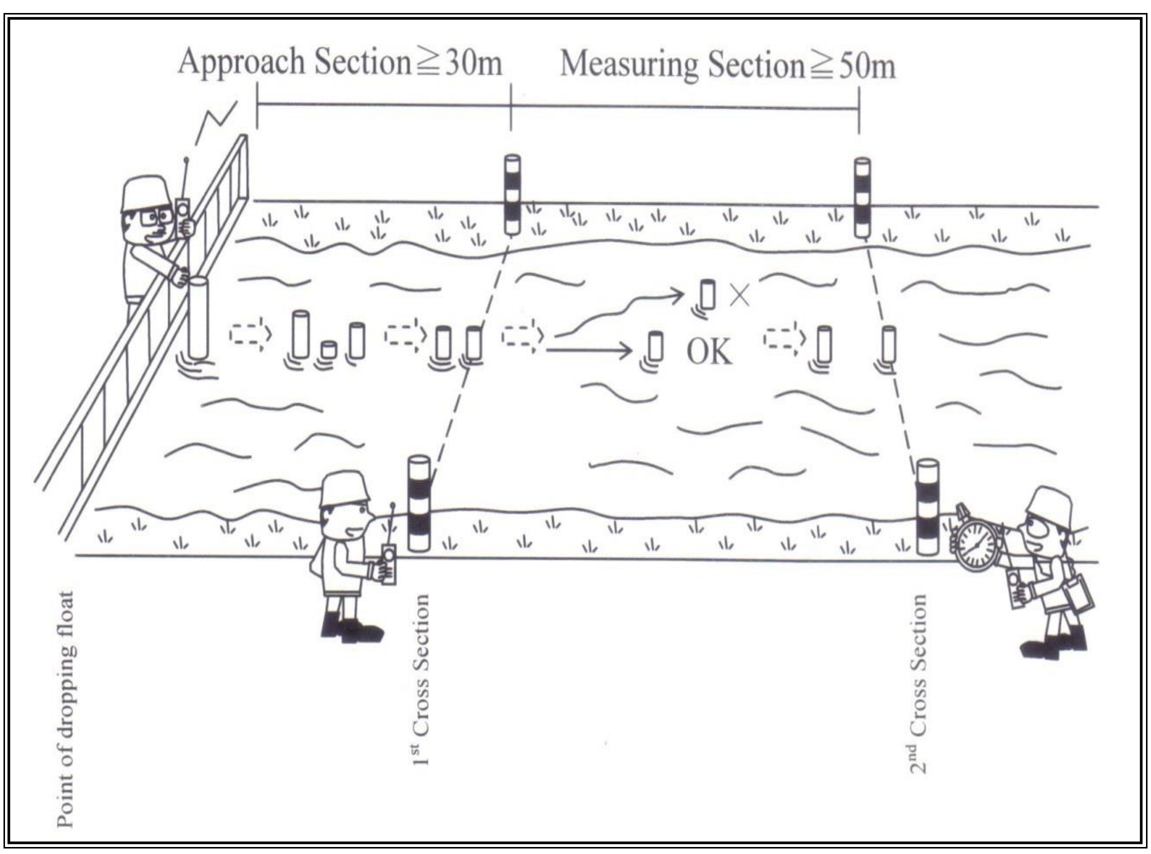
Method 3
Float Method

Floats and timer as tools to measure velocity
Echo sounder as a tool to measure depth
Range Finder as a tool to measure Horizontal distance

Procedure:

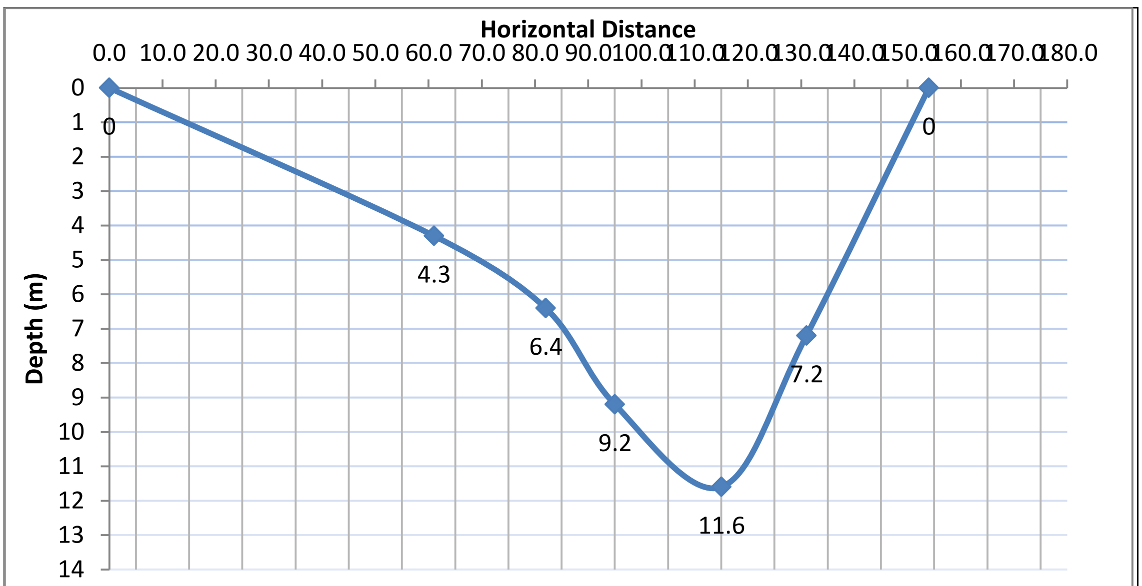
1. Use bamboo to serve as floats, they must be of the same length .

2. From the Left side of the bridge (estimated edge in line with the left water edge), measure 5 points going to the right edge. Take note of the distances from each point.
3. Assign two persons to watch out for the float on the river, the first person should stand 50m from the section below the bridge, and the second, 100m from the first 50 m.
4. After all is set, drop the floats individually recording the time it reaches the first 50m as the starting time, and the time it reaches the 100m distance as the finishing time.
5. Each float undergoes at least 2 trials.
6. When these trials are already done, consider two cross sections, they must be straight to where the 2 watchers stand along the river.
7. Use a boat to take readings of depth through echo sounder, the cross sections in this case is divided into 8 verticals.
8. Also, use a range finder to measure horizontal distance from each vertical.
9. These are done in each cross section from right to left bank and from left to right bank.

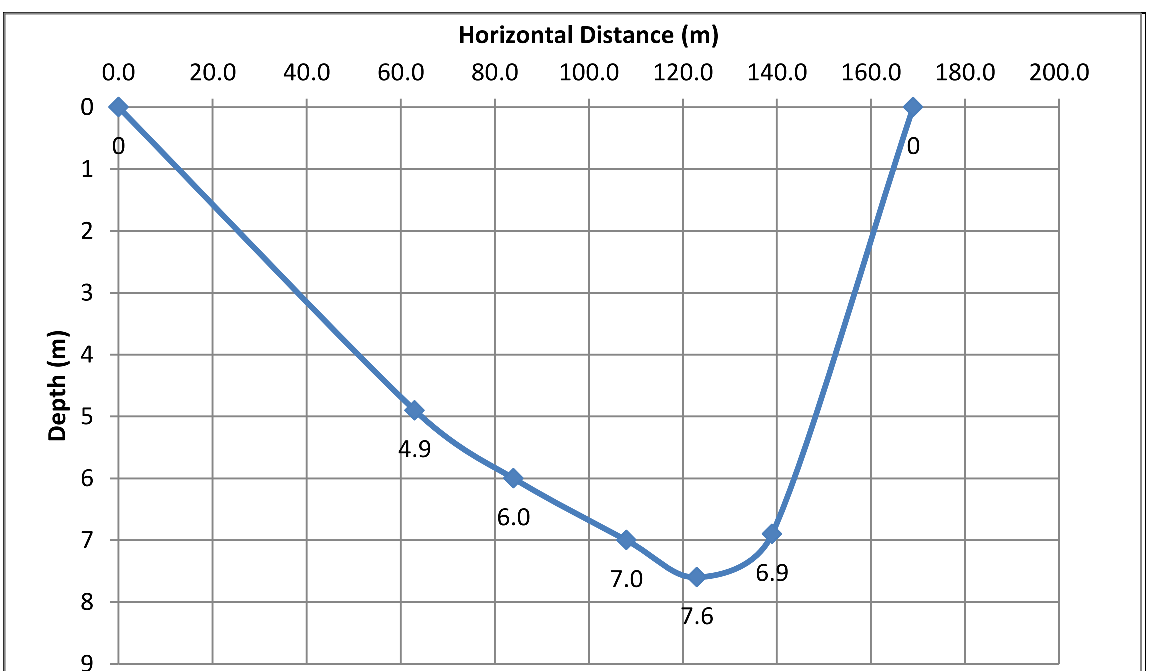


The summary of data is as follows:

Station	Time (s)	Distance (m)	Velocity (m/s)	Cross Section 1			Cross Section 2		
				HD (m)	Depth (m)	Q (cms)	HD (m)	Depth (m)	Q (cms)
0				0.0			0.0		
1	129	100	0.775	61.0	4.3	136.67	63.0	4.9	159.53
2	106	100	0.943	82.0	6.4	102.64	84.0	6.0	127.36
3	75	100	1.333	95.0	9.2	202.40	108.0	7.0	182.00
4	100	100	1.000	115.0	11.6	208.80	123.0	7.6	117.80
5	125	100	0.800	131.0	7.2	112.32	139.0	6.9	126.96
6				154.0			169.0		
Total						**762.83**			**713.65**
Average						**738.24**			



Float Method Cross Section 1



Float Method Cross Section 2

Analysis associated to the limitations of the method during the field work:
(Aided with a few recommendations)

In points 2, 4 and 5 of trial 2, the bamboos were not able to float due to its structure, the materials were not properly cut for them to float immediately.

The river has a low flow, the floats traversed in a slanting direction; ideally, it reached the first cross section at a longer time than when it traversed a straight path. This limitation causes an error to the computation of velocity. This would mean that float method is more accurate during high flows only because the floats tend to travel in a more or less straight line. Also, this method would be more preferable in cross sections with definitely no obstructions.

Upon computation of area, the 8 verticals had been reduced into 5 in such a way that it will only include the interval of verticals where the 5 floats reached since they have traversed a slanting direction. This is to make the velocity and depths fit in a certain assumed area**. In this case, tag lines with marks instead of range finders should be used to serve as horizontal boundaries across a cross section.** The 5 chosen verticals are merely concentrated at the left bank where most of the floats crossed. This would say that the discharge computed could not be that much representative of the entire cross section but more on the left bank of the cross section.

Another way is to estimate a time when the floats reached the cross section in a straight path based on the time it reaches the cross section in a slanting direction. The distance 100m will be divided by this estimation to get velocity.
When this is followed, the measurements of depths and horizontal distance can remain as is but still a tag line with marks will be more accurate rather than range finders.

Method 4
(Slope- Area Method)

Total station and prism as tools to measure Vertical and horizontal distance including horizontal angle.

Echo sounder to measure river depth

Range finder to measure horizontal distance across a river

Procedure:

1. Obtain a measure of the starting gage height.
2. Start measuring through a known benchmark, using total station and rod with prism.

   To compute for Height of the instrument , **H= El (BM) + Height of rod – Vertical distance (BS)**

3. Select next turning points which are across a cross section, that is in this case, extends from High Water mark (LB) to High water mark (RB).

   To compute for Elevation of the next turning points, **El = H.I =Vertical distance(FS) – Height of rod**

4. The total station can be relocated so as to have a better view of the prism, but the Height of the instrument relative to the mean sea level should also be recomputed.

5. The height of the rod can also be extended up to a few meters in instances where the total station can no longer hit the prism due to obstructions.

6. Choose another cross section which extends from High water mark (LB) to High Water mark (RB), measure its distance from the first cross section.

7. Acquire a profile of the next cross section by doing the same process. (In this case, 35 TPs were chosen for the 2 cross sections)

8. Obtain a measure of the finishing gage height.

The data are as follows:

Station	VD (m)	HA (deg-min-sec)	HD (m)	Elevation m)	Remarks
BS1	0.776	24° 34' 00"	8.642	9.538	
TP1	-0.792	225° 45' 20"	209.487	7.546	
BS2	-0.586	119° 20' 20"	37.278	9.332	
TP2	0.142	233° 09' 20"	104.74	8.274	HWM1 RB
TP3	-0.526	248° 45' 20"	35.468	7.606	
TP4	0.326	247° 59' 00"	11.93	8.458	
TP5	0.197	107° 14' 00"	19.707	8.329	
TP6	-0.889	84° 18' 40"	50.677	7.243	
BS3	0.68	293° 30' 90"	7.821	5.658	
TP8	-1.735	78° 04' 20"	103.399	5.848	
TP9	-3.018	77° 58' 00"	109.198	5.131	RB WE1
TP10	1.192	79° 50' 40"	284.873	3.848	HWM1 LB
TP7	-1.018	82° 34' 00"	77.728	8.066	
TP11	0.906	79° 51' 20"	212.274	7.772	

TP12	-0.743	80° 06' 40"	201.579	6.123	
TP13	-3.057	80° 22' 40"	199.509	3.809	LB WE1
BS4	0.263	350° 48' 00"	108.521	8.483	
TP14	-1.12	80° 14' 20"	96.287	3.763	RB WE2
TP15	-0.996	69° 56' 00"	93.386	6.287	
TP16	-3.421	72° 10' 20"	243.28	3.862	LB WE2
TP17	1.092	72° 37' 20"	250.296	8.375	
TP18	-0.746	70° 34' 40"	87.386	6.537	
TP19	0.539	73° 21' 00"	302.738	7.822	HWM2 LB
TP20	-0.663	69° 50' 40"	67.002	6.62	
TP21	0.083	61° 13' 00"	26.601	7.366	
TP22	-0.041	20° 11' 40"	8.162	7.242	
TP23	1.039	290° 51' 20"	16.994	8.322	
TP24	0.973	255° 05' 20"	38.451	8.256	HWM2 RB
BS5	0	351° 28' 20"	277.511	8.746	
TP25	-0.867	91° 02' 00"	100.313	4.279	RB WE3
TP26	-3.41	91° 21' 40"	249.356	4.136	LB WE3
TP27	-1.507	90° 42' 00"	97.097	6.039	
TP28	0.788	87° 36' 20"	290.393	7.534	HWM3 LB
TP29	-1.098	91° 01' 20"	257.446	6.448	
TP30	-0.845	92° 00' 00"	93.696	6.701	
TP31	-0.379	100° 18' 20"	53.608	7.167	
TP32	0.1	122° 52' 40"	9.815	7.646	
TP33	-0.018	238° 39' 40"	15.247	7.528	
TP34	0.94	256° 58' 40"	19.332	8.486	
TP35	1.26	267° 08' 40"	45.271	8.806	
TP36	1.086	267° 33' 20"	94.086	8.632	HWM3 RB

Discharge measurement: 2, 389.70 m^3/s

Analysis associated to the limitations of the Method during the field work: (issues and concerns)

The presence of a known benchmark must always be considered in the selection of gauging site especially that the method is dependent on this. In this regard, the computations of the elevations of the river bed is made through establishing the elevation of the water edge, specifically, the right water edge, and by subtracting it to the measure of depth in the echo sounder, but take note that this measure of depth could be affected by the boulders and rocks beneath the river.

Negative values of Vertical distance from the total station mean that the prism is located at a lower elevation than the total station.

The process could be very tedious in such a way that the computations made by the total station do not include the elevations of each turning point, as a result, the surveyor still needs to allot additional time after getting informations in the field to manually compute for each elevation. In addition, the cross sections must be projected as a straight line, but since the selection of turning points made in the banks could not easily follow a straight path, a sort of interpolation in the horizontal distance between those TP's must be taken note in sketch-making and in the computation of actual discharge.

The reason why the method is only limited to getting the profile of the cross section and the highest flood water mark attained by the river relative to the mean sea level is to measure the discharge at the time of flooding. That is why, Slope-area method is usually done right after the flooding event so that the highest flood water marks are still visible. Together with the values of the river width, total area, wetted perimeter and hydraulic radius, the discharge

during the flooding event can be computed even without the value of the river velocity.

Method 5

(Rope-weight method)

Sounding weight to serve as a load
Rope to serve as a measuring device

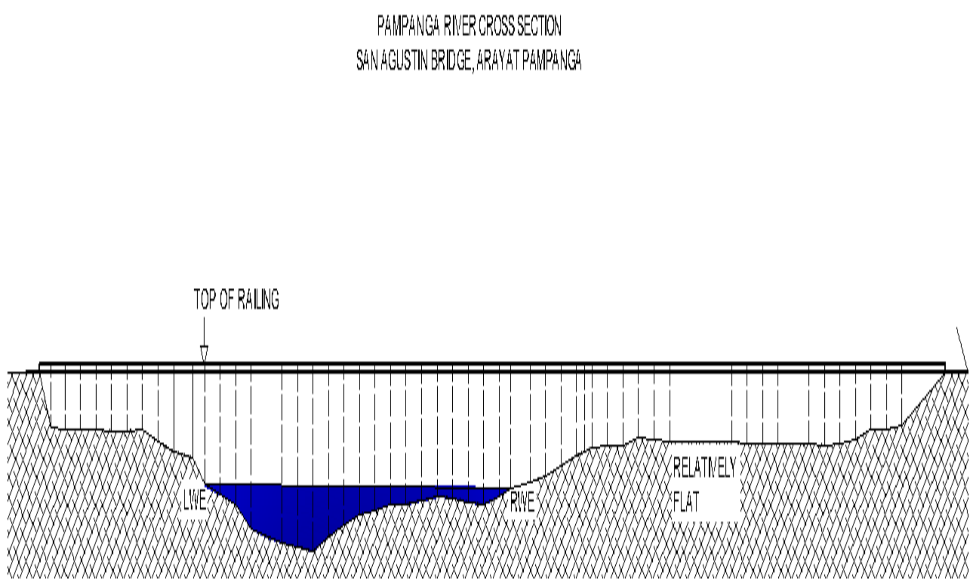
1. Measure the elevation of the bridge railings relative to the mean sea level through a total station and prism.
2. Start measuring the depth of the ground just below the edge of the bridge by using a rope with marks. The elevation of the ground relative to the mean sea level is computed by subtracting the elevation of the railings relative to the mean sea level to the depth of the ground measured by the rope.
3. Do the same process until the other edge of the bridge is reached, in this case, the horizontal distance between points in the bridge is 5m.

The data are as follows:

station	distance	elevation	water sfc.	depth	mean depth	area	wetted perimeter
				x			
0	0.00	15.402	4.00	0	4.00	x	x
3.8	3.80	8.712	4.00	0	4.00	x	x
8.34	4.54	8.512	4.00	0	4.00	x	x
13.34	5.00	8.512	4.00	0	4.00	x	x
18.34	5.00	8.342	4.00	0	4.00	x	x
23.34	5.00	8.342	4.00	0	4.00	x	x
28.34	5.00	8.422	4.00	0	4.00	x	x
33.34	5.00	7.052	4.00	0	4.00	x	x
38.34	5.00	5.912	4.00	0	4.00	x	x
43.34	5.00	5.142	4.00	0	4.00	x	x
49.54	6.20	1.762	4.00	2.24	1.12	6.94	7.06
53.34	3.80	0.742	4.00	3.26	2.75	10.44	3.93
58.34	5.00	-0.548	4.00	4.55	3.90	19.52	5.16
63.34	5.00	-3.568	4.00	7.57	6.06	30.29	5.84
68.34	5.00	-5.318	4.00	9.32	8.44	42.22	5.30
78.34	10.00	-5.258	4.00	9.26	9.29	92.88	10.00
83.34	5.00	-5.628	4.00	9.63	9.44	47.22	5.01
88.34	5.00	-6.168	4.00	10.17	9.90	49.49	5.03
93.34	5.00	-4.388	4.00	8.39	9.28	46.39	5.31
98.34	5.00	-3.078		x	x	x	5.17
103.34	5.00	-1.688		x	x	x	5.19
108.34	5.00	-1.318		x	x	x	5.01
113.34	5.00	-0.678		x	x	x	5.04
118.34	5.00	-0.478		x	x	x	5.00
123.34	5.00	-0.078		x	x	x	5.02
128.34	5.00	0.342		0	0.00	x	x
133.34	5.00	0.292		0	0.00	x	x
138.34	5.00	-0.198		x	x	x	5.02
143.34	5.00	-0.528		x	x	x	5.01
148.34	5.00	0.532		0	0.00	x	x
152.14	3.80	1.482		0	0.00	x	x
158.34	6.20	2.132		0	0.00	x	x
163.34	5.00	2.952		0	0.00	x	x
168.34	5.00	4.092		0	0.00	x	x
173.34	5.00	5.362		0	0.00	x	x
175.84	2.50	5.902		0	0.00	x	x
178.34	2.50	6.382		0	0.00	x	x
183.34	5.00	6.402		0	0.00	x	x
188.34	5.00	6.402		0	0.00	x	x
193.34	5.00	7.442		0	0.00	x	x
198.34	5.00	7.152		0	0.00	x	x
203.34	5.00	6.982		0	0.00	x	x
208.34	5.00	6.982		0	0.00	x	x
213.34	5.00	6.982		0	0.00	x	x

218.34	5.00	6.982		0	0.00	x	x
223.34	5.00	6.982		0	0.00	x	x
228.34	5.00	6.722		0	0.00	x	x
233.34	5.00	6.752		0	0.00	x	x
238.34	5.00	6.752		0	0.00	x	x
248.34	10.00	6.852		0	0.00	x	x
253.34	5.00	6.602		0	0.00	x	x
258.34	5.00	6.682		0	0.00	x	x
263.34	5.00	7.262		0	0.00	x	x
268.34	5.00	8.412		0	0.00	x	x
273.34	5.00	8.542		0	0.00	x	x
278.34	5.00	8.912		0	0.00	x	x
292.34	14.00	15.402		0	0.00	x	x

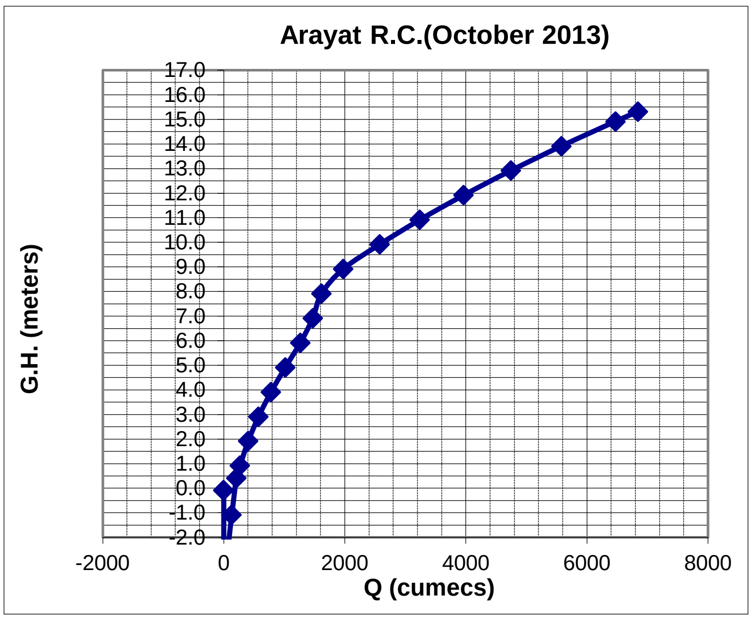
Total Width	**292.34**
Total Area	**345.3752**
W. P (P)	**93.11635115**
Hydraulic Radius ®	**3.709071454**
Mean sect. Depth	**1.181416159**

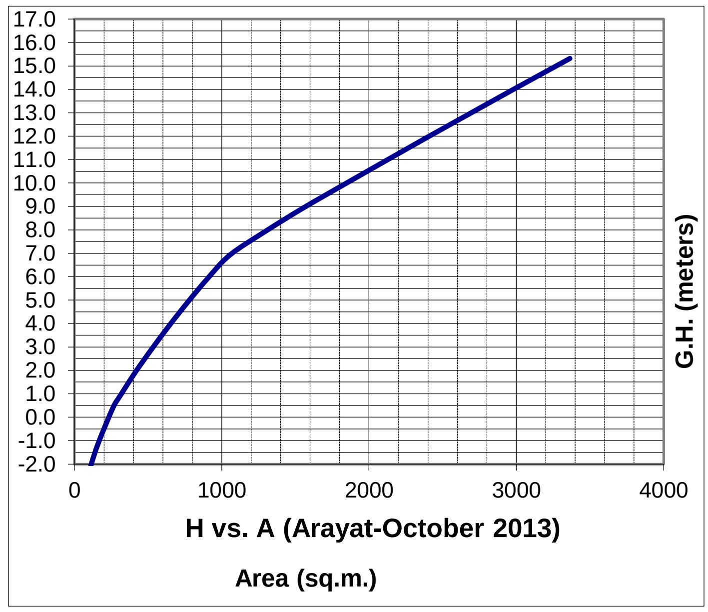


The data in the table above were used to derive the rating curve equation. Full Bank at 15.320 m, water levels have an interval of 1m, that is:

Rating Curve Development for				***Pampanga River***			
	Measuring Station:			***Arayat***			
	Drainage Area:						
	River:						
	Location:						
	Elev. S.G."0" rdg.=		***0.082***	**meters**			
Meas. #	Day	Month	Year	S.G.(m)	Q(m^3/sec)	Remarks	
				15.320	6846.291		
				14.918	6473.362		
				13.918	5581.845		
				12.918	4745.562		
				11.918	3965.539		
				10.918	3240.859		
				9.918	2577.586		
				8.918	1976.518		
				7.918	1616.029		
				6.918	1471.252		
				5.918	1266.117		
				4.918	1018.181		
				3.918	782.183		
				2.918	576.024		
				1.918	405.261		
				0.918	268.817		
				0.418	209.401		
				-1.082	132.877		
				-2.082	85.635		
				-3.082	45.374		

The Rating Curve and Rating curve Equation are as follows:





Rating Curve equation:

$$Q = 0.026 \; [H - (-10.10)]^{3.851}$$

Purpose of inclusion of the method to the 4 previous methods during the field work:

Compared to Slope-Area method, Rope-weight method in this **case assumes that the water level during flood event reaches the bridge and aims to compute the discharge at that assumption**. After which, decreasing measures of water level (usually 0.5 meters below the previous water level) is taken into assumption and again, resulting to values of discharges respectively until it reaches Thalweg. **This method yearns values needed for the rating curve and further explains how the discharge at that river varies at different water levels, this relationship is expressed through the rating curve equation.**

Negative gage heights would mean that a portion beneath the river is even below the “0” gage height. This leads into a conclusion that Staff gauges are not always built at the thalweg of the river.

Summary and Conclusion:

The list of the Average Discharge measurements among the 4 methods (excluding Rope-weight method) is shown in the following table:

Method	**Discharge (m^3/s)**
Current Meter	13.86
ADCP	288.881
Float	738.24
Slope-Area	2,389.70

A relatively low discharge measurement for current meter rooted from a low and stagnant flow of the river on the day of the survey. This was brought about by a nearby dam closing its gates for irrigation purposes. On the other hand, the result for float method is influenced by moderately flowing water also coming from the dam since this was done prior to current meter method. But, this highly estimated result is also affected by a slight discrepancy in the survey process, such as inaccuracy of width of each vertical acquired from the range finder, prolonged travel time of the floats and uncertainty of the areas where the floats are assumed to cross. Lastly, Slope-Area Method has the highest value among the 4 methods because the measurement of discharge is assumed to be from the highest flood water marks, (Left and Right Bank).

Although the five methods can function independently, their differences compliment each other. Each method attains its effectiveness as the river undergoes varying conditions; each usage depends on what the river setting calls for.

Current meter method, the most conventional of the 5 methods done, can be very useful both in high flows or in low flows, whether it is done on boat, bridge or just by wading. **ADCP** is useful in thick and muddy rivers. It provides a fast and software-based recorded data which makes the measurement spontaneous and accurate. **Slope-Area and float method** are most suitable after a flooding event, while current meter and ADCP method can be very threatening due to this condition where river flow is of high water velocity and water level.

Lastly, The rope-weight method can be an accompanying method together with the slope-area. This method is very crucial in arriving at a rating curve and rating curve equation, which gives the surveyor an idea of what will be the discharge at different water levels. This will be one the main ingredient in making River Flood warnings at the end process.

Although the acquired measures of discharge during this field work can come with a substantial difference from the actual measurements in the nearby gauging station (PRBFFC), the errors/ discrepancies made can serve as significant limitations. Having noted basic slip-ups such as miscalibration and misusage of device, improper selection of site, under/overestimation of values and the use of faulty materials hopefully leads to a better and appropriate parametric measures in the next coming river surveys.

END

Prepared by:
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