Republic of the Philippines
Department of Environment and Natural Resources
MIMAROPA Region
Provincial Environment and Natural Resources Office

July 5, 2023

MEMORANDUM

FOR : The Regional Executive Director
DENR MIMAROPA

THRU : The OIC, ARD for Technical Services
DENR MIMAROPA

FROM : The OIC, PENR Officer
Oriental Mindoro

SUBJECT : **SUBMISSION OF PROGRESS REPORT ON THE ACTIVITIES FOR THE WATERSHED CHARACTERIZATION AND VULNERABILITY ASSESSMENT OF ALAG-BACO WATERSHED FOR THE 2ND QUARTER OF CY2023**

Submitted is the 2nd Quarterly Report CY 2023 of CENRO Socorro on the Watershed Characterization and Vulnerability Assessment of Alag-Baco Watershed.

The Technical Working Group has conducted activities such as stakeholders' orientation, planning of activities with the Watershed Management Planning Team (WMPT), data gathering and initial writing.

Primary data collection such as soil and water samples from different strategic location of the watershed comprising the upstream, midstream and downstream areas. Soil permeability and bulk density were measure using the equipment from the Regional Office while the water samples were brought to the EMB-MIMAROPA Oriental Mindoro Satellite Office in Calapan City.

Secondary data gathered such as FLUP, CLUP and maps of municipalities within the watershed. Analysis of geo-morphological characteristics of the watershed has also been conducted.

Attached is the report of CENRO Socorro and photo-documentation for information, and record.

ALAN L. VALLE

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PENRO Tracking No. 2306000442
TSD/CDS/dmits

Republic of the Philippines
Department of Environment and Natural Resources
MIMAROPA Region
Community Environment and Natural Resources Office

DENR-MIMAROPA REGION
PROVINCIAL ENVIRONMENT AND NATURAL RESOURCES OFFICE
ORIENTAL MINDORO
RECEIVED BY:
DATE: JUN 27 2023

June 27, 2023

MEMORANDUM

FOR : The Regional Executive Director

THRU : The OIC, PENR Officer

FROM : The CENR Officer

SUBJECT : **SUBMISSION OF PROGRESS REPORT ON THE ACTIVITIES FOR THE WATERSHED CHARACTERIZATION AND VULNERABILITY ASSESSMENT OF ALAG-BACO WATERSHED FOR THE 2ND QUARTER OF CY 2023**

Respectfully submitting the Progress Report on the activities for the Watershed Characterization and Vulnerability Assessment of Alag-Baco Watershed for the 2nd Quarter of CY 2023.

For information and record.

RODEL M. BOYLES

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CENRO Socorro – CDS

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Republic of the Philippines
Department of Environment and Natural Resources
MIMAROPA Region
Community Environment and Natural Resources Office

June 19, 2023

MEMORANDUM

FOR : The CENR Officer

THRU : The Chief, CDS

FROM : The Watershed Focal

SUBJECT : **SUBMISSION OF PROGRESS REPORT ON THE ACTIVITIES FOR WATERSHED CHARACTERIZATION WITH VULNERABILITY ASSESSMENT OF ALAG-BACO WATERSHED FOR THE SECOND QUARTER**

Respectfully submitting the progress report/milestone undertaken for the Watershed Characterization with Vulnerability Assessment of Alag River Watershed for the second quarter of CY 2023.

Please be informed that the following activities were conducted based on the annotated outline provided in DMC 2008-05 and Technical Bulletin No. 16-A to wit:

- Stakeholders Orientation, Leveling-off and consultation meeting/ workshop conducted at Vencio's Garden Hotel and Restaurant Brgy. Tawiran, Calapan City, Oriental Mindoro dated May 03, 2023;
- Identified the key stakeholders for the management of the watershed [5 municipalities, 51 Barangays, PAgO, PG-ENRO/Planning and 4 NGAs (NIA, DPWH, NCIP, DA-BFAR)];
- Levelling off with WMPT on the scheduling and activities to be undertaken;
- Conducted coordination and collection of secondary data needed from different sources such as FLUP, CLUP and Maps of municipalities within the watershed and other related literature;
- Completed thematic maps and delineation of watershed area;
- Conducted soil collection for soil analysis, bulk density, soil permeability including water sampling collected in the different sampling site of the watershed area;
- Analyzed geo-morphological characteristic of the watershed; and
- Started write-up on the watershed characterization and vulnerability assessment report based on the annotated outline provided in DMC 2008-05 and Technical Bulletin No. 16-A.

For information and record.

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Republic of the Philippines
Department of Environment and Natural Resources
MIMAROPA Region
Community Environment and Natural Resources Office

GEO-TAG PICTURES TAKEN DURING THE CONDUCT ON THE ACTIVITIES FOR WATERSHED CHARACTERIZATION WITH VULNERABILITY ASSESSMENT OF ALAG BACO WATERSHED

Figure 1: Stakeholders Orientation, Leveling-off and consultation meeting/ workshop conducted at Vencio's Garden Hotel and Restaurant Brgy. Tawiran, Calapan City, Oriental Mindoro dated May 03, 2023.

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Figure 2: Conducted coordination and collecting secondary data needed from different municipalities FLUP, CLUP and Maps.

Figure 3: Conducted water sampling collection in different sampling site in the watershed area.

Figure 3: Conducted soil collection for soil analysis, bulk density and soil permeability in different sampling site in the watershed area.

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ALAG-BACO RIVER WATERSHED CHARACTERIZATION REPORT

Table of Contents

I. INTRODUCTION AND BACKGROUND INFORMATION

A watershed refers to a region that is geographically defined and encompasses the land drained by a network of streams. Watersheds are commonly employed to comprehend the movement of water in the hydrologic cycle, and they hold significant relevance in comprehending human actions that impact the various aspects of this cycle(Brooks et al., 2012).

Watersheds serve as diverse hubs where various crucial processes converge, offering essential ecosystem functions that sustain plants, animals, and humans alike. Within these ecosystems, a multitude of services are provided, including but not limited to nutrient cycling, carbon storage, erosion control, soil development, enhanced biodiversity, creation of wildlife corridors, water retention, water purification, flood management, timber resources, and recreational opportunities (Aldridge et al., 2018).

The Alag-Baco river watershed is one of the five principal river basins in Cluster 3, located in the island of Mindoro. It covers an area of 50,095.26 ha 2,258 square and spans two provinces namely, Occidental and Oriental Mindoro. The watershed also covers 5 municipality namely; Abra de Ilog, Puerto Galera, San Teodoro, Baco, Naujan, and Calapan City. The watershed comprises a total of 48 barangays, with varying distribution among the covered municipalities. There are 10 barangays in Naujan, 29 barangays in Baco, 5 barangays in San Teodoro, 3 barangays in Puerto Galera, and 1 barangay in Abra de Ilog. The watershed drains into the Verde Island Passage and Tablas Strait, which are rich in marine biodiversity. The watershed also hosts the Mts. Iglit-Baco National Park, which is home to the endangered tamaraw and other endemic species. The watershed provides various ecosystem services such as water resources, food security, energy and biodiversity conservation. According to DMC 2008-05 it is categorized under large sized watershed.

This watershed characterization was conducted to provide the necessary information for understanding and describing the biophysical and socio-economic characteristics and features of the Watershed.

Specifically, it aims to:

1. Assess the physical (geological, vegetative, climatological, erosion potential) institutional aspect and socio-economic conditions of the watershed.
2. Identify the issues and concerns being faced by Watershed.
3. Recommend programs, interventions and conservation measures that can be implemented in Alag-Baco Watershed to address the identified issues and concerns.

The information gathered from this characterization will be used to assess its vulnerability to natural hazards, i.e., flash floods, erosion, and landslides and such other factors contributory to the rapid degradation of its forest cover. Results will be used in the identification of necessary interventions, and mitigating measures needed as well as the complementary efforts of stakeholders in the formulation of its management plan.

II. PRESENT STATE OF THE WATERSHED

This section discussed the present condition of the watershed, its physical environment, land classification, and or legal status of the land, Land capability, Land use, Climate, Hydrology, Infrastructure, Biological features, Socioeconomic and demographic, and information on Behavioral/cultural pattern of the watershed.

2.1 PHYSICAL ENVIRONMENT

The Alag-Baco River Watershed play a very crucial role for the affected communities within the barangays covered, it being the major source/supplier of

irrigation purposes to the hectares of rice fields as its service area as well as for the domestic consumption of households. Much worth mentioning are the socio-economic activities generated thru its recreational opportunities and the livelihood generated which in any other way added to poverty alleviation of the communities covered by said watershed.

a) Variability of water supply

The current state of the watershed has resulted in a slight decline in water volume available for the service areas, particularly during the summer months, primarily due to reduced or absent rainfall and the decreased water holding capacity of the watershed resulting from forest degradation. Additionally, prolonged inundation leads to a significant increase in surface runoff, overwhelming the soil's capacity to retain such a large volume of water.

Climate change plays a major role in the variability of water supply in the Alag-Baco River Watershed, as it disrupts weather patterns, leading to extreme weather events, unpredictable water availability, exacerbating water scarcity, and contaminating water sources. These impacts have the potential to greatly impact the quantity and quality of water necessary for children's survival. Climate warming is expected to further exacerbate water loss through increased evapotranspiration, driven by higher evaporative potential and shifts in plant species.

This greater evapotranspiration can result in reduced streamflow, groundwater recharge, flow rate, and regional water supplies. Furthermore, mismanagement of groundwater, including unsustainable drilling for irrigation purposes, contributes to the variability of water supply.

b) Erosion and Siltation of Riverbeds

Erosion refers to the geological process wherein natural forces like wind or water wear away and transport earthen materials. Human activities, particularly

farming and land clearing, can leave the soil susceptible to erosion. Along the Alag-Baco River, noticeable erosion of riverbanks has occurred, resulting in a decrease around titled lands used for agricultural production.

To address this severe erosion, the Department of Environment and Natural Resources (DENR) has initiated measures to stabilize the riverbanks. They have implemented gabion structures and undertaken vegetative measures, such as bamboo planting along certain riverbanks. Various physical factors, including excessive sand and gravel extraction, flash floods, intense rainfall, flooding of bank soils, and wave action, may contribute to this erosion. Human factors such as deforestation, resource extraction, changes in vegetation from forests to cultivated farms, and the construction of dams and bridges can also play a role in riverbank erosion.

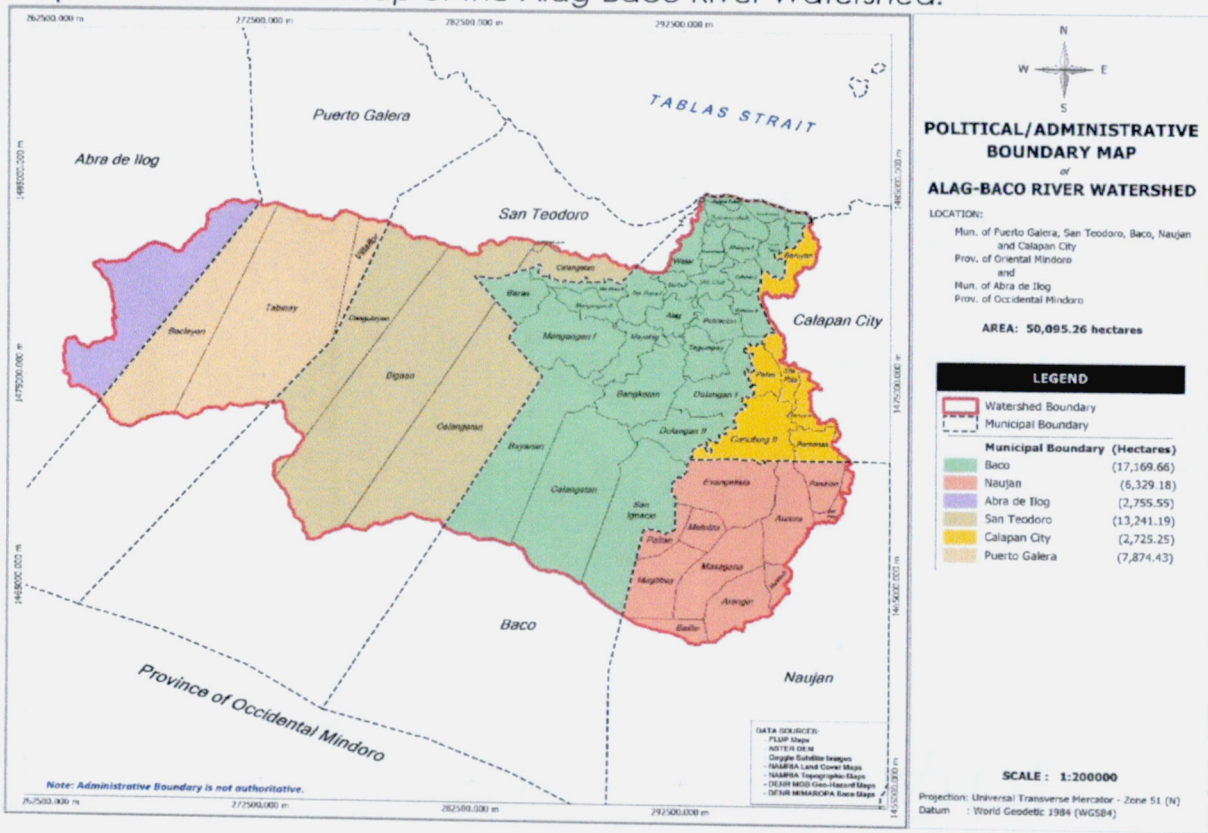
The impacts of riverbank erosion are predominantly social (displacement due to the loss of homes), economic (decreased sources of livelihood due to reduced farmland areas and productivity), and political (government projects to mitigate erosion and allocation of significant funds to flood victims). On the other hand, siltation refers to the accumulation of fine particles like sand, mud, and other materials in reservoirs, creeks, streams, rivers, and other bodies of water. Siltation is often caused by soil erosion. The impacts of siltation include the destruction of fish breeding grounds, flooding, deterioration of water quality affecting human and animal use, and increased conflicts among resource users. Climate change, particularly the increase in frequency and intensity of rainfall events, can exacerbate erosion and lead to a higher amount of sediment being washed into rivers, lakes, and streams.

2.1.1 GEOPHYSICAL LOCATION

The Alag-Baco watershed forest reserve has a total land area of 50,095.26 hectares and is categorized as a large-scale watershed (DENR, 2008). The watershed watershed is located at 1483779.022 meters north, 1462379.665 meters

south, 263008.560 meters west, and 300900.762 east. It is within the municipal jurisdiction of Abra de Ilog, Puerto Galera, San Teodoro, Baco, Naujan, and Calapan City. The watershed consists of a total of 48 barangays, distributed across different municipalities. Specifically, there are 10 barangays in Naujan, 29 barangays in Baco, 5 barangays in San Teodoro, 3 barangays in Puerto Galera, and 1 barangay in Abra de Ilog. The entire watershed spans a total area of 50,095.26 hectares, classified as a large-sized watershed according to DMC 2008-05.

Map 1. Administrative map of the Alag-Baco River Watershed.



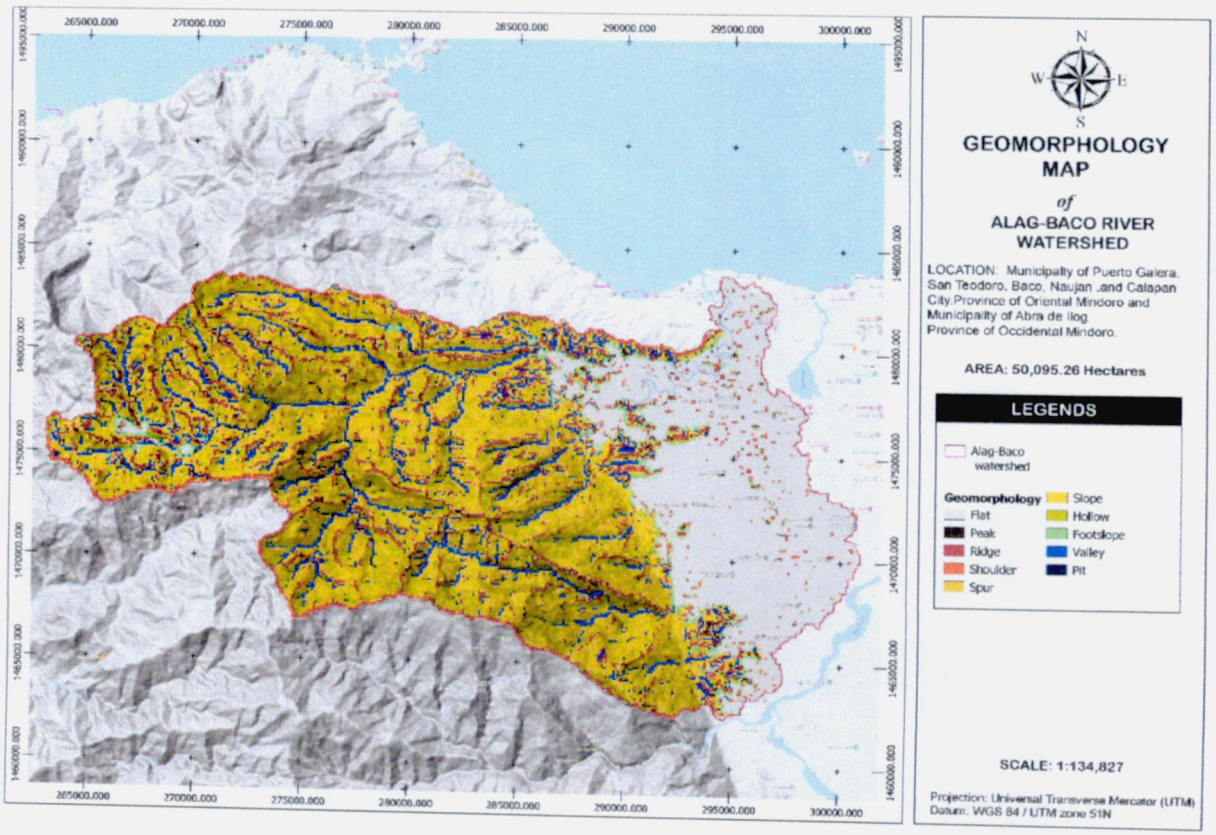
2.1.2 TOPOGRAPHY/GEO-MORPHOLOGICAL FEATURES

Topography refers to the physical characteristics and shape of the land. It determines the steepness of the land surface and stream channels. The height and steepness of the hills, floodplains, and channels contribute to the erosive

power of the water in a watershed and its stream channels. Steep slopes allow the force of gravity to quickly accelerate the speed of flowing water. The faster water flows the more energy or power it must erode and move soil, sand, gravel, boulders, and debris. Topography also affects the sinuosity of streams. Channels with low gradients usually meander back and forth, while steep channels do not wind back and forth as much but often have more riffles.

Geo-morphological features play a crucial role in influencing the amount and velocity of water moving over land surfaces, as well as their effects on soil erosion potential and suitability for various land uses. These features, such as slope, topography, drainage patterns, and soil characteristics, interact to shape the hydrological processes occurring in a particular area. Here's a discussion of how these features affect water movement, erosion potential, and land use suitability.

Map 2. Geomorphology map of Alag-Baco River Watershed.



Generally, most of the area is flat having slope class of 0-8 % specially on the north-eastern portion of the watershed. It can be noted that there is a sudden increased gradient on its south-western portion indicating a steep to very steep slope.

A. Watershed-shape Parameters:

1. Area (A)

One of the most significant watershed parameters for the hydrologic study is the watershed area, commonly referred to as the drainage area. It reflects the volume of water that can be generated from rainfall. The bigger the area, the bigger the catchment basin and the more water during peak flows and the longer time for the flood to flow to the stream outlet (Desai & Mishra, 2022). Watersheds can be classified into small, medium, and largescale watersheds depending on their area.

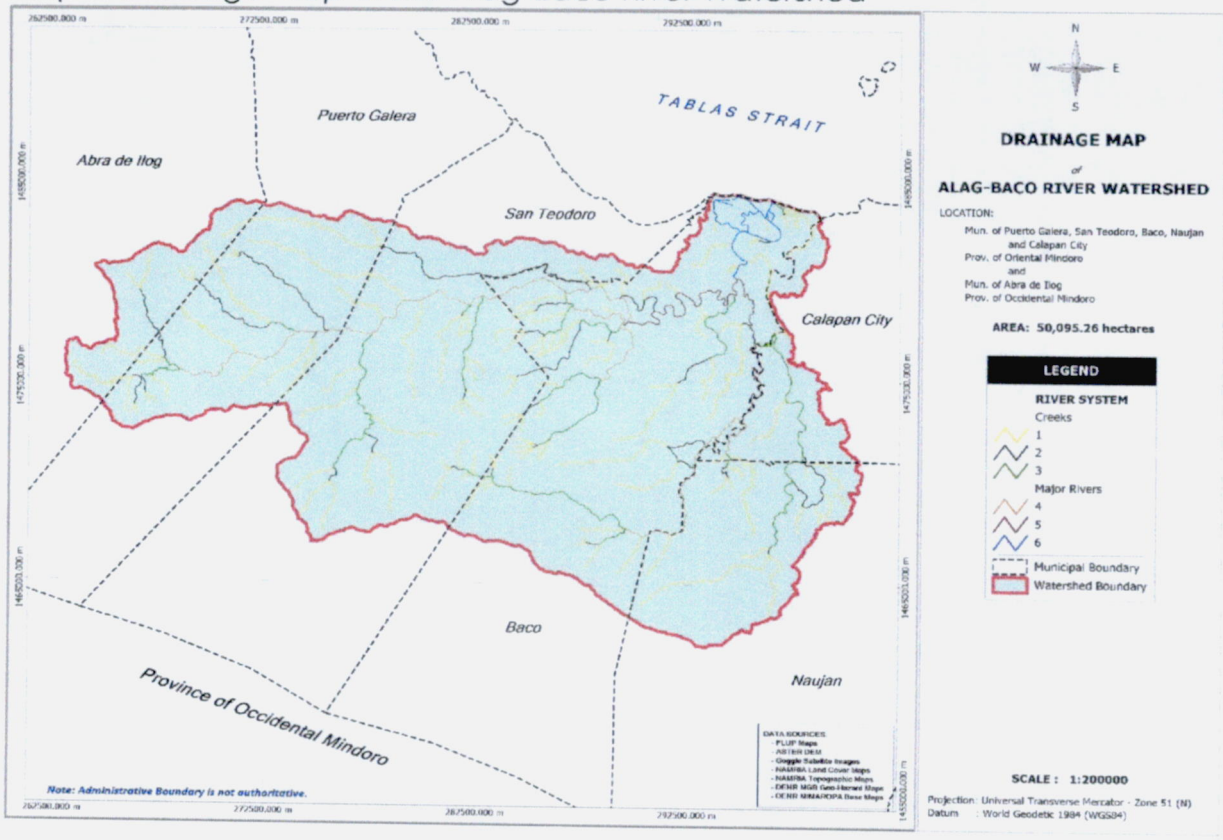
The Alga-Baco River Watershed has a total land area of 50,095.26 Ha or 500.9526 Km2 and has a length of 38.00 Km. The watershed is classified as a large-scale watershed (watershed with areas from 10,000 to 50,000 hectares) based onMC-2008-05 (DENR, 2008). The spatial analysis of the watershed reveals that most of the streams are upstream of the watershed. The streams form a branching tree pattern which allows the head waters to travel down to streams, to creeks and eventually to the Malaylay and Pulang river. The movement of the water from upstream down the slope is pulled by gravity where run-off flows to the main channel. During intense rainfall, runoff coming from the upstream tributaries of the watershed travel faster to the main channel. However, as it passes through its major tributaries, runoff starts to slow down to the main outlet due to the elongated shape and slope of the lower portion of the watershed.

Table 1. Classification of watersheds according to size ((DENR, 2008)).

Watershed area	**Watershed Classification**
Less than 10,000 Ha	Small

More than 10,000 ha to 50,000 ha	Medium
Above 50,000 ha	Large

Map 3. Drainage Map of the Alag-Baco River Watershed



2. *Gravelius form factor (Gf)*

Gravelius form factor indicates the distribution and intensity of rainfall over the entire area of the watershed. Gravelius form factor is calculated as the ratio between the area of the basin and the square of the length of the main channel (Di Leo & Di Stefano, 2013).

Basins with lower form factors tend to have a more elongated shape. These basins typically have longer flow paths, which can result in slower drainage and increased travel time for runoff. As a result, they may experience greater water

accumulation during intense rainfall events, potentially leading to increased runoff and flooding.

On the other hand, basins with higher form are generally more circular or compact in shape. These basins often have shorter flow paths, allowing for faster drainage and reduced travel time for runoff. Consequently, they may exhibit better resilience to intense rainfall, as the water is quickly transported downstream, reducing the risk of flooding.

$Gf = \frac{Area\ of\ the\ basin}{Length\ of\ the\ main\ channel^2}$ (Di Leo & Di Stefano, 2013)

The Alag-Baco River watershed has a Gravelius form factor of 6.78. This value indicates that the watershed is elongated and has a complex shape. The calculated concentration time for the watershed is 3.12 hours this means that it takes more than three hours for a drop of water from the farthest point of the basin to reach the outlet.

3. *Bifurcation ratio (Rb)*

The bifurcation ratio is the ratio of the number of stream branches of a given order to the number of stream branches of the next higher order (

RaoK et al., 2010)

It is the relationship of a branching pattern of a drainage network and is defined as the ratio between the total numbers of stream segments of one order to that of the next higher order in a drainage basin.

Values for the bifurcation ratio ranges from less than 5(low) to more than 5(High) in which the geologic structures do not distort the drainage pattern and varies among researchers. The bifurcation ratio value is used to depict the behaviors of flood discharge. A lower bifurcation ratio means a higher discharge with lower peak since many higher order streams are draining to fewer lower order

streams. On the contrary, higher bifurcation ratio value is indicative of a greater number of lower stream orders catching water from lesser number of high order streams, hence, lower discharge with broader peak.

$$Rb = \frac{Nu}{Nu+1} = \frac{\text{No.of stream segment of order 'u'}}{\text{No.of stream segment of next higher orde}}$$ (DENR, 2008)

The Alag-Baco river watershed has a bifurcation ratio of 3.31. This value indicates low peak flow and that chances of flooding are also low. However, a long duration of intense rainfall like a typhoon may cause flooding, especially in the lower barangays located within the watershed.

4. ***Elongation ratio (Re)***

The elongation ratio is the ratio of the diameter of a circle of the same area as the basin to the maximum basin length. An elongation ratio with a value of less than 0 indicates that the watershed is elongated while a value of 1 indicates a circular-shaped watershed. Watersheds with a low elongation ratio have high relief and steep slopes while a high elongation ratio indicates flat land with low relief and low slopes and indicates that the areas are having high infiltration rates and low run-off(Sukristiyanti et al., 2018).

$$Re = \left(\frac{2}{Basin\ lenght}\right)\left[\frac{Area}{3.1416}\right]0.5$$ (DENR, 2008)

Table 2. Standard and classification of the river basin elongation (Hamad, 2020).

Elongation Ratio	**Shape of the Basin**
<0.7	Elongated
0.7-0.8	Less elongated
0.8-0.9	Oval
>0.9	Circular

The elongation ratio of the Alag-Baco watershed is 0.4, indicating that the watershed is elongated and has high relief and steep slopes. It also indicates that

the watershed is less efficient when it comes to the movement of runoff from its tributaries going to its main channels.

5. ***Circulatory ratio (Rc)***

The circularity ratio is the ratio between the areas of a watershed to the area of the circle having the same circumference as the perimeter of the watershed (Sukristiyanti et al., 2018). The value of the circulatory ratio approaching 1 tends to be circular while values having 0 or less are linear.

The elongation ratio of the Alag-Baco river watershed is 5.98, indicating the watershed is less efficient when it comes to the movement of runoff from its tributaries going to its main channels. The generated value also indicates that the watershed is elongated and has high relief and steep slopes.

6. *Basin length (Lb)*

Conceptually the basin length is the distance traveled by the surface drainage and is sometimes more appropriately labeled as hydrologic length. This length is generally used in computing a time parameter, which is a measure of the travel time of water through a watershed.

The computed basin length of the Alag-Baco river watershed is 38 km and since the watershed basin is described as elongated the generated value would indicate that water flowing from the watershed tributaries would take time to travel from the farthest point in its perimeter to the watershed outlet.

B. Watershed – relief feature of Alag-Baco river watershed

1. Relief ratio (Rr)

The relief ratio measures the overall steepness of the drainage basin; hence it also indicates the intensity of erosion in the slope of the watershed. When the value of

the relief ratio is high it indicates that most of the watershed has steep slopes and is susceptible to erosion. Run-off is generally in steeper basins, producing more peaked basin discharges and greater erosive power, thus, a higher relief ratio means higher peak flow and faster movement of storm water to the outlet.

$$Rr = \frac{B_h}{L_b} \text{(DENR, 2008)}$$

The generated relief ratio of the Alag-Baco river watershed is 2168. this value is high indicates that most areas within the watershed has steep to very steep slope and that the intensity of erosion within the watershed is also high.

III. References

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