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BAGONG PILIPINAS

JAN 13 2025

MEMORANDUM

FOR : **THE DIRECTOR**
Forest Management Bureau
DENR, Visayas Ave., Diliman, Quezon City

FROM : **THE REGIONAL EXECUTIVE DIRECTOR**
DENR-CAR

SUBJECT : **SUBMISSION OF THE ANNUAL MONITORING REPORT FOR THE WATERSHED INSTRUMENTATION PROGRAM (WIP) IN CAR FOR CY 2024**

We respectfully submit our annual monitoring report for the Watershed Instrumentation Program (WIP) for CY 2024. The watershed monitoring instruments were installed within the Chico River Watershed. These watershed instruments are as follows:

Instruments	Location	Status/Remarks
1. Automated Weather Station (AWS)	Mt. Data, Bauko, Mt. Province	Port 4 VP-4 sensor malfunctioned, needs replacement
	Poblacion, Tinglayan, Kalinga	Port 3 ECRN-100 does not transmit data, needs replacement
	CENRO Pinukpuk, kalinga	Active and Functional
2. Automated Water Level Station (AWLS)	Canao Bridge, Calanan, Tabuk City, Kalinga	Active and Functional
3. Conductivity, Temperature, and Depth (CTD) Ground Water Sensor (GWS)	CENRO Pinukpuk, Kalinga	Active and Functional

For information, record, and reference.

ENGR. PAQUITO T. MORENO JR., CESO III

DENR-CAR
OFFICE OF THE REGIONAL EXECUTIVE DIRECTOR
By: SHAIRA A. GUTIERREZ Time: 0905
Engineering Aide
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DENR-CAR
Office of the Regional Executive Director

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WATERSHED INSTRUMENTATION PROGRAM IN CAR ANNUAL REPORT FOR CY 2024

I. Introduction

The initiation of the Watershed Instrumentation Program, along with the installation of stationary monitoring instruments, began in November 2017, adhering strictly to established guidelines outlined in the FMB Technical Bulletins No. 17, 28, and 33. These guidelines ensure a high standard of uniformity and operational efficiency. The array of advanced instruments deployed includes Automated Weather Stations (AWS), Automated Water Level Stations (AWLS), and Conductivity, Temperature, and Depth (CTD) Groundwater Sensors—all pivotal for scientific, real-time monitoring of watershed dynamics.

Nationwide, a total of 47 AWS, 16 AWLS, and 8 CTD groundwater sensors have been strategically installed across selected priority watersheds. Within the Cordillera Administrative Region (CAR), the Chico River Watershed—a vital subwatershed of the Cagayan River Basin, whose water sources originate from the provinces of Benguet, Mountain Province, Apayao, and Kalinga—has been designated as a pilot area for this advanced instrumentation. The installation of these instruments was executed with precision to ensure comprehensive coverage: three AWS units were established at critical locations within the subwatershed, specifically at Mt. Data in Bauko (representing the upper stream), at Poblacion in Tinglayan, Kalinga (serving the middle stream), and at the CENRO Pinukpuk compound in Kalinga (representing the lower stream).

Additionally, the AWLS and CTD Groundwater Sensors were strategically positioned at Canao Bridge in Calanan, Tabuk City, and at the CENRO Pinukpuk compound in Kalinga, respectively. These hydrometeorological monitoring stations actively transmit data captured by their sensors to a cloud database, accessible via two dedicated websites: zentracloud.com and xylem.cloud/hydrosphere.com.

The installation of these specific instruments, which generate real-time data, is crucial for accurately characterizing the conditions of the watershed. This information is vital for comprehensive watershed management strategies, encompassing water resource planning, flood mitigation, water quality protection, ecosystem conservation, and scientific research. Furthermore, the Department of Environment and Natural Resources (DENR) has leveraged this program to monitor stream discharge and meteorological conditions, enabling communities to enhance their disaster risk reduction management. The data acquired is made available to Local Government Units (LGUs), Municipal Disaster Risk Reduction and Management Councils (MDRRMC), and various researchers and stakeholders invested in sustainable watershed stewardship.

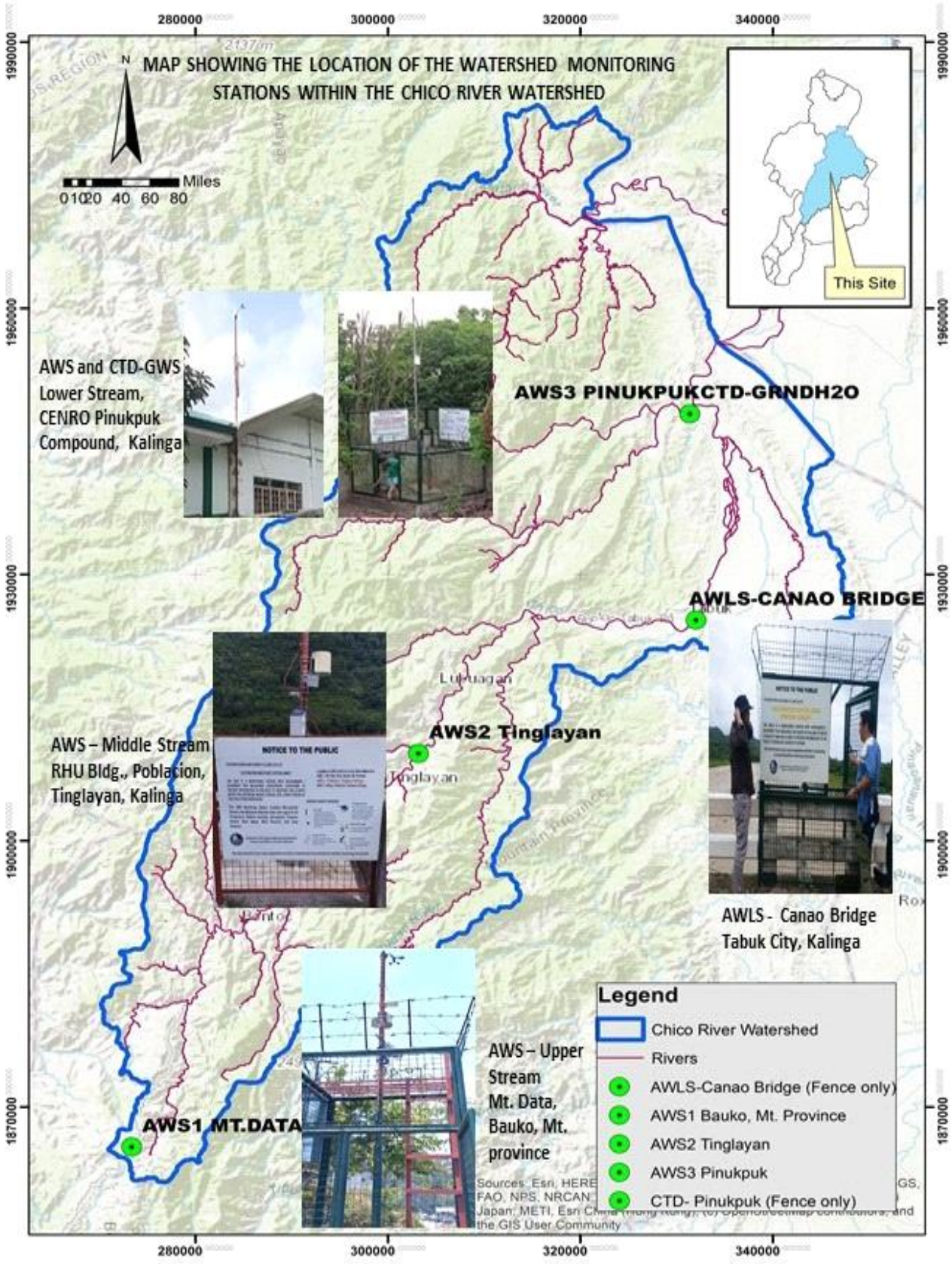
Moreover, the installed watershed instrumentation within the Chico River has been invaluable during the successive typhoons that impacted our region this year, particularly within the Cagayan River Basin. Data collected from these instruments assisted officials in making informed decisions during times of disaster.

The following table identifies the instruments that were installed in its specific locations:

Table 1. Locations of monitoring stations

Name of Instruments	Purpose	Location	Status/Remarks
Automated Weather Station (AWS)	For monitoring meteorological conditions	1. CENRO Pinukpuk compound (Junction Pinukpuk Kalinga) 2. Poblacion Tinglayan, (Middle Stream) 3. Mt. Data, Bauko Mt. Province (Upper Stream)	-Functional -Port 3 ECRN-100 does not transmit data, need replacement -Port 4 VP-4 sensor malfunctioned, need replacement
Automated Water Level Station (AWLS)	For monitoring of water level of a river	Canao Bridge, Tabuk City Kalinga	-Functional
Conductivity, Temperature, and Depth (CTD)	For monitoring water quality in terms of Conductivity Salinity Temperature Pressure Density	CENRO Pinukpuk compound, Junction Pinukpuk Kalinga	-Functional

Figure 1. Map showing the Strategic Location of Monitoring stations



II. Data Analysis

1. Data Monitoring, Access, and Comparative Analysis

Data monitoring and access were conducted on a monthly basis, ensuring a comprehensive overview of the environmental conditions. The data collection process utilized 15-minute real-time interval readings from each microclimate sensor, which were then meticulously consolidated and summarized to generate daily, weekly, and monthly meteorological reports. The aggregated data presented in this report provides valuable insights into the various atmospheric and hydrological conditions prevailing across the upper, middle, and lower streams of the Chico River Watershed.

Furthermore, data generated from the installed watershed instruments for the calendar year 2024 were systematically downloaded and analyzed, focusing on climatological aspects based on specific parameters for each watershed segment. This extensive analysis aims to enhance our understanding of the watershed's dynamics and support informed decision-making for sustainable environmental management.

2. Summary of the Data Collected for CY 2024:

a. Automated Weather Station (AWS)

The installed AWS with multi-parameter sensors measures air temperature, relative humidity and pressure, rainfall (precipitation), wind speed and direction, and solar radiation. After the reinstallation of the calibrated AWS on April 17-21,2023, it was observed that some of the microclimatic sensors does not transmit data thus, the staff of the Regional Office conducted checking of the instruments and this issue was also referred to the PhilInstrument Corporation as the lone provider of the said instruments. As a result, the status of one microclimatic sensor of the AWS which is the Port 4 VP-4 Sensor responsible for reading the value of the relative humidity and air temperature of the area that is installed at the Mt. Data, Bauko, Mt. Province malfunctioned and was not able to provide the accurate data. Also, one microclimatic sensors of the AWS which is the Port 3 ECRN-100 responsible for reading the precipitation of the area that is installed at Poblacion, Tinglayan, Kalinga does not transmit data on the website. These malfunctioned sensors were recommended for replacement. For this year, CY 2024, this office requested additional fund to the Central Office to be used in procuring the identified malfunctioned microclimatic sensors which is subjected for the availability of funds.

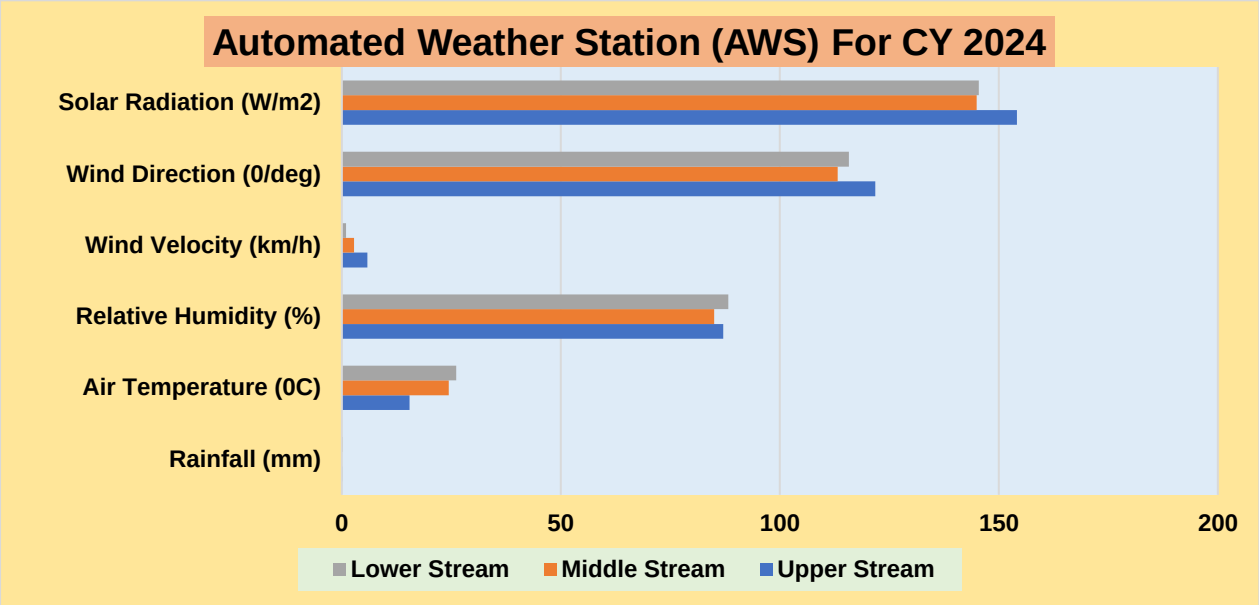
The tables below show the average data generated from AWS installed along Chico River for the month of January to December, 2024.

Table 2: Average Data of Automated Weather Stations

Automated Weather Station (AWS)					
Parameter	***Number of Instruments Installed***	***Period Covered***	***Upper Stream***	***Middle Stream***	***Lower Stream***
Rainfall (mm)	3	January to December, 2024	0.11	0.00	0.22
Air Temperature (^{0}C)	3		15.46	24.41	26.10
Relative Humidity (%)	3		87.08	85.02	88.25
Wind Velocity (km/h)	3		5.83	2.77	0.98
Wind Direction (^{0}/deg)	3		121.78	113.18	115.78
Solar Radiation (W/m2)	3		154.15	144.93	145.40

*****The red colored text was the sensor that malfunctioned, thus the data transmitted due to the sensor is not accurate*

Figure 2. Average Data of Automated Weather Stations



b. Automated Water Level Station (AWLS)

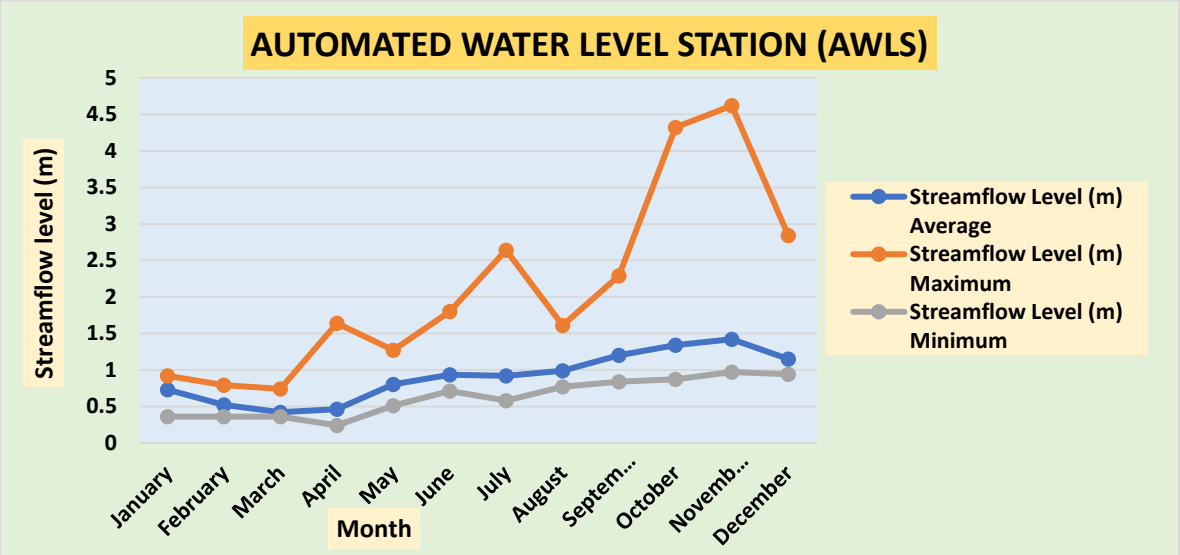
The Automated Water Level Station (AWLS) continuously monitors stream flow rates at designated intervals. Located at Canao Bridge in Tabuk, Kalinga, the AWLS is programmed to record data every 15 minutes. The table below presents the average, maximum, and minimum readings collected from the installed instruments. The data indicate that water levels are low during the dry season and tend to rise in response to the rainy season.

In 2024, the region faced several typhoons, including Carina, Dindo, Enteng, Ferdie, Gener, Helen, Igme, Julian Kristine, Leon, Marce, Nika, Ofel, and Pepito, which resulted in severe flooding, landslides, significant losses to livelihoods, livestock, agricultural products, and tragically, fatalities. According to the data collected, the maximum water level recorded for the entire year was 4.62 meters on November 11, 2024, during the occurrence of Super Typhoon Nika.

Table 3. Automated Water Level Station data

AUTOMATED WATER LEVEL STATION (AWLS)			
Period Covered	**Streamflow Level (m)**		
	Average	**Maximum**	**Minimum**
January	0.73	0.92	0.36
February	0.52	0.79	0.36
March	0.42	0.74	0.36
April	0.46	1.64	0.24
May	0.80	1.27	0.51
June	0.93	1.8	0.71
July	0.92	2.64	0.58
August	0.99	1.61	0.77
September	1.20	2.29	0.84
October	1.34	4.32	0.87
November	1.42	4.62	0.97
December	1.15	2.84	0.94
Grand Mean	**0.91**	**2.12**	**0.63**

Figure 3. Automated Water Level Station data



c. Conductivity Temperature and Depth (CTD)-Ground Water Sensors

The Conductivity Temperature and Depth (CTD)-Ground Water Sensors monitoring station, measures the Ground Water Level (mm) and its conductivity (mS/cm). The average of groundwater level accumulated for the year is 1908.98mm or 1.91 meters and its average electrical conductivity is 0.90 mS/cm.

Six (6) units of 10HS model of soil moisture measuring sensors were also installed underground at the lower streams of the watershed at a maximum depth of 30 cm and the minimum depth of 5 cm. These sensors measure volumetric water content via the dielectric constant of the soil using capacitance/frequency domain technology. Four (4) sensors were installed at CENRO Pinukpuk compound connected to the CTD data logger with measurements taken at intervals of 5 cm, 10 cm, 20 cm, and 30 cm in sandy loam soil. The average recorded data for the 5 cm, 10 cm, 20 cm, and 30 cm soil depths is 22.84%, 20.87%, -16.25%, and 15.13%, respectively

The gathered data is summarized monthly, including averages, maximum, and minimum values, as shown in the table below.

Table 4. Conductivity, Temperature and Depth (CTD)-Groundwater Station and Soil Moisture Content

CONDUCTIVITY TEMPERATURE AND DEPTH (CTD)-GROUND WATER SENSORS AND SOIL MOISTURE CONTENT																		
Period Covered	Ground Water Level (mm)			Conductivity (mS/cm)			Soil Moisture (%) 5cm			Soil Moisture (%) 10cm			Soil Moisture (%) 20cm			Soil Moisture (%) 30cm		
	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min
January	2836.98	2912.00	2743.00	0.87	0.89	0.83	25.00	3.20	18,7	24.72	39.10	-37.90	2.56	15.40	-14.10	21.49	25.00	15.40
February	2590.19	2759.00	2419.00	0.88	0.89	0.88	14.23	19.00	12.10	43.00	43.00	7.40	12.77	22.50	4.50	13.26	15.50	11.90
March	2320.87	2434.00	2188.00	0.89	0.89	0.88	12.70	12.70	11.00	28.61	43.50	7.50	0.60	10.90	-10.60	11.80	12.40	11.10
April	1982.83	2128.00	1811.00	0.88	0.89	0.88	9.37	10.50	8.30	27.30	39.70	7.20	-10.92	3.10	-27.20	9.60	15.50	8.00
May	1625.14	1828.00	1445.00	0.88	0.90	0.88	16.18	22.10	9.10	21.11	29.90	3.10	-23.93	-14.80	-29.50	12.88	22.70	-42.80
June	1422.68	1507.00	1380.00	0.92	0.95	0.89	25.29	33.30	18.80	6.26	29.40	-28.20	-24.32	0.00	-41.90	15.97	23.70	-1.60
July	1339.44	1525.00	1147.00	0.95	0.97	0.94	24.81	33.60	12.90	-11.60	29.50	-27.00	-31.26	0.00	-42.90	16.51	22.50	-0.10
August	1276.40	1320.00	1152.00	0.97	0.98	0.96	27.66	35.10	22.90	8.61	31.80	-27.30	-30.05	0.00	-41.40	17.00	25.10	-1.20
September	1359.50	1512.00	1276.00	0.97	0.98	0.96	28.72	35.50	22.00	24.11	32.90	7.00	-31.53	0.00	-41.90	15.62	24.50	-2.70
October	1618.83	1984.00	1464.00	0.94	0.96	0.89	29.61	33.90	26.20	25.15	33.30	7.30	-24.10	0.00	-42.40	15.82	24.80	-27.40
November	2239.41	2510.00	1902.00	0.86	0.89	0.85	30.16	33.60	27.30	26.47	29.80	24.30	-18.80	-7.30	-30.90	16.06	25.60	-1.40
December	2295.53	2507.00	2098.00	0.84	0.85	0.83	30.29	33.90	27.70	26.69	30.30	24.70	-16.00	-7.30	-32.00	15.55	22.50	-0.30
Grand Mean	**1908.98**	**2077.17**	**1752.08**	**0.90**	**0.92**	**0.89**	**22.84**	**25.53**	**18.03**	**20.87**	**34.35**	**-2.66**	**-16.25**	**1.88**	**-29.19**	**15.13**	**21.65**	**-2.59**

3. Analysis of Data by Correlating Various Parameters

3.1 Rainfall (Precipitation) and Air Temperature

The correlation of rainfall and air temperature for the lower stream:

The interplay between air temperatures and rainfall is a multifaceted phenomenon that significantly influences atmospheric conditions and, by extension, various ecological and human systems. Warmer air temperatures tend to accelerate the process of evaporation, thereby increasing the moisture content in the atmosphere. This heightened humidity can lead to a rise in condensation and, ultimately, greater precipitation, translating to more rainfall. Consequently, there is a discernible positive correlation between elevated temperatures and increased rainfall, as warmer conditions enhance evaporation rates, which, in turn, contribute to a moister atmosphere ripe for precipitation.

However, this dynamic relationship is not uniform and can be significantly affected by local climatic characteristics, geographical factors, and other environmental variables. In certain scenarios, higher temperatures may also lead to increased evapotranspiration rates, which can exacerbate dry conditions and result in diminished rainfall. Conversely, cooler temperatures can decrease the air's moisture-holding capacity, promoting stable atmospheric conditions that reduce the likelihood of rainfall events. Nevertheless, cold temperatures can also be associated with specific weather systems—such as cold fronts or cyclones—that can trigger the uplift of moist air, leading to cloud formation and precipitation. Thus, the relationship between air temperature and rainfall is layered and complex, bearing implications for ecosystems, agriculture, water resources, and human activities alike.

Based on the gathered data presented in Figure 2., the average annual rainfall of the lower stream is 0.06mm and the average annual air temperature is 26.61^0C. Notably, temperatures peaked at 29.5°C in May while dipping to a low of 23.0°C in April. The observed relationship of elevated temperatures correlating with low rainfall can be attributed to intensified evaporation processes. As air temperatures rise, the rate at which water transitions from liquid to vapor increases, leading to heightened evaporation from bodies of water, soil, and plants. This escalation in evaporation limits the moisture available for precipitation, culminating in diminished rainfall.

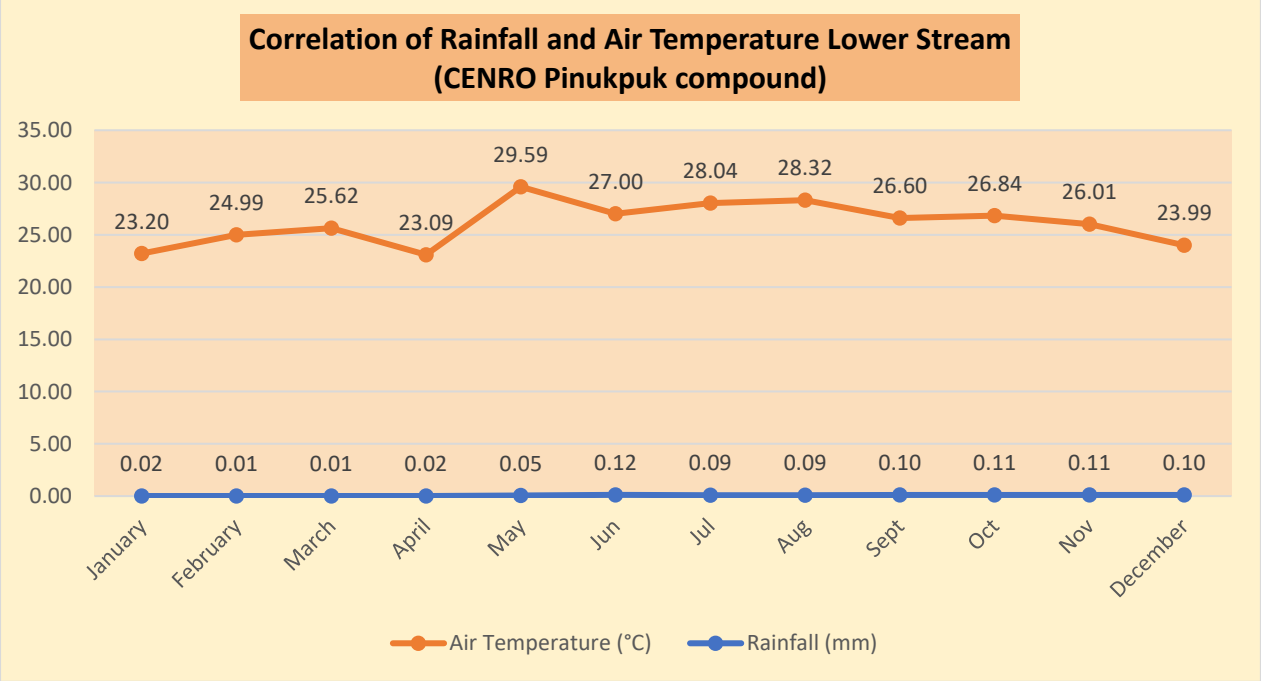
On the other hand, low temperature and low rainfall is caused by limited moisture capacity, the atmosphere may have limited capacity to hold moisture. This can result in lower amounts of water vapor available for condensation and precipitation. Also, cold temperature can hinder the convective processes that drive rainfall. Convection involves the vertical movement of air masses, which helps in the formation of clouds and subsequent rainfall. When temperatures are low, the convective activity maybe reduced, leading to lower chances of precipitation.

The impacts of low rainfall and low temperature can have significant consequences for various aspects of the environment and humans. Consequences include diminished agricultural productivity, water scarcity, the emergence of drought conditions, detrimental ecological impacts, reduced hydropower generation, compromised water quality, and significant socio-economic challenges affecting human livelihoods.

Table 5. Correlation of rainfall and air temperature Lower Stream (CENRO Pinukpuk compound)

Period Covered	Rainfall (mm)	Air Temperature (°C)
January	0.02	23.20
February	0.01	24.99
March	0.01	25.62
April	0.02	23.09
May	0.05	29.59
Jun	0.12	27.00
Jul	0.09	28.04
Aug	0.09	28.32
Sept	0.10	26.60
Oct	0.11	26.84
Nov	0.11	26.01
December	0.10	23.99
Average	**0.09**	**26.61**

Figure 4. Correlation of rainfall and air temperature Lower Stream (CENRO Pinukpuk compound)



The table below presents a comprehensive ranking of the monthly average temperatures for the lower stream, organized from the coldest month, which is April, to the warmest month. Additionally, it includes the corresponding average monthly rainfall for each of these months.

Table 5. Ranking of Air Temperature - Precipitation of the Lower Stream

Rank	Month	Air Temperature (°C)	Rainfall (mm)
2nd	January	23.20	1.79
4th	February	24.99	0.01
5th	March	25.62	0.01
1st	April	23.09	0.02
13th	May	29.59	0.05
9th	June	27.00	0.12
10th	July	28.04	0.09
12th	August	28.32	0.09
7th	September	26.60	0.10
8th	October	26.84	11.12
6th	November	26.01	0.11
3rd	December	23.99	0.10

3.2 Rainfall and Streamflow Level

Since the AWLS was strategically established in between the middle and lower stream of the watershed, the total recorded precipitation accumulated from AWS Mt. Data was correlated with the average water level recorded per month. The relationship between rainfall and streamflow/level is a crucial aspect of hydrology and water resources which contributes to the flow of rivers and streams.

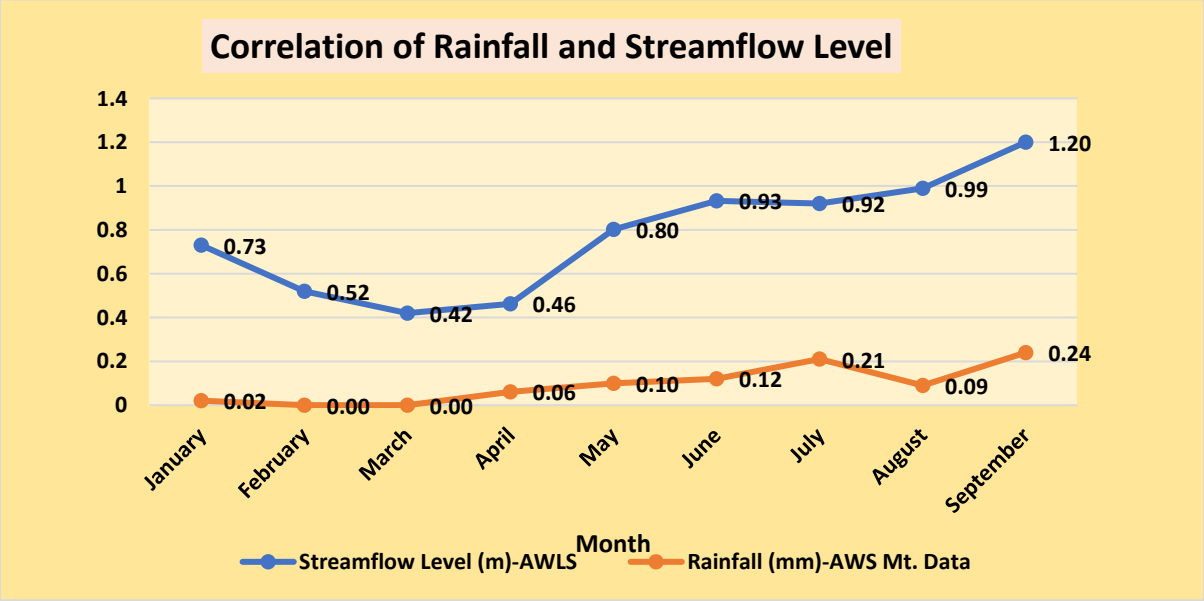
As shown on the graph below, the gathered data for the whole year shows a low rainfall rate and streamflow level that ranges from 0.00mm to 0.34mm and 0.42m to 1.42m, respectively. It was in the month of October that had the highest precipitation recorded, which was 0.34mm, with an average streamflow level of 1.32 meters. This implies that as the rainfall rate rises, the water level will also increase, and vice versa. Thus, fluctuations in water level may depend on climatic conditions and other climate factors within the upper and middle streams of the watershed. This means that minimal rainfall on the watershed leads to a low streamflow level, indicating a potential water scarcity situation, which can have implications such as: drought conditions, decreased streamflow, reduced water supply, ecological consequences, economic and societal implications, decreased water quality, affecting the entire watershed.

With this, it is essential to monitor and manage water resources efficiently, promote sustainable water use practices, and develop strategies for drought resilience and adaptation to changing conditions. For February and March, there was no occurrence of rain, due to the onset of the dry season.

Table 6. Correlation of Rainfall and Streamflow Level

Month	Streamflow Level (m)-AWLS	Rainfall (mm)-AWS Mt. Data
January	0.73	0.02
February	0.52	0.00
March	0.42	0.00
April	0.46	0.06
May	0.80	0.10
June	0.93	0.12
July	0.92	0.21
August	0.99	0.09
September	1.20	0.24
October	1.34	0.34
November	1.42	0.20
December	1.15	0.18
Average	**0.91**	**0.18**

Figure 5. Correlation of Rainfall and Streamflow Level



3.3 Rainfall and Conductivity, Temperature and Depth (CTD)- Ground Water Level

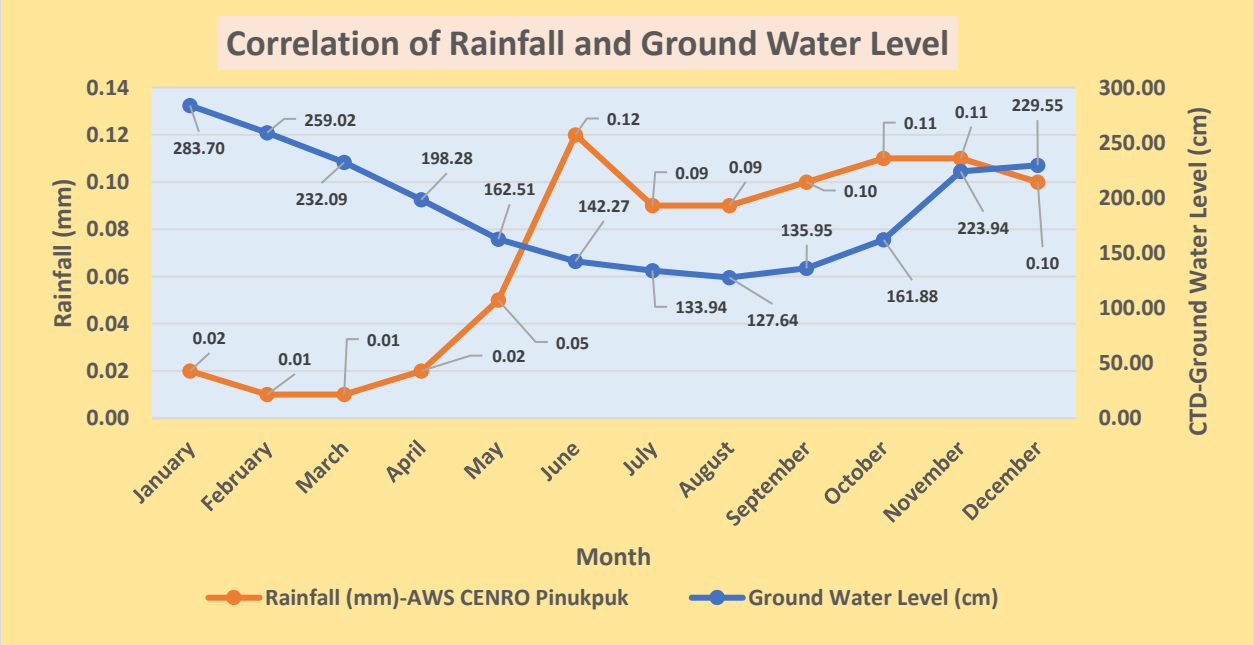
The AWS and CTD monitoring stations were established in the same area. Rainfall and groundwater levels are closely correlated, as rainfall is a primary source of recharge for groundwater systems. As illustrated in the graph, there is minimal rainfall throughout the year, and groundwater levels fluctuate between 127.64 cm and 283.70 cm. This range suggests that groundwater is indeed receiving recharge, which can occur through rainfall, surface water infiltration, or other sources, depending on local hydrogeological conditions. Monitoring groundwater levels is essential for various reasons, including understanding how groundwater pumping affects the availability of water in aquifers and the amount of water in surface bodies that interact with groundwater. It provides insights into the aquifer's response to precipitation and the potential availability of groundwater resources. Understanding the range of groundwater levels is critical for designing sustainable extraction rates and ensuring the long-term viability of the groundwater system.

Furthermore, the maximum electrical conductivity measured in milliSiemens per centimeter increased from last year's reading of 0.86 mS/cm to 0.90 mS/cm. This value exceeds the Philippine standard for potable water, which ranges from 0.2 to 0.8 mS/cm. This increase indicates that the instrument continues to detect dissolved substances, chemicals, and minerals present in the groundwater.to detect dissolved substances, chemicals, and minerals that may be present in the groundwater.

Table 7. Correlation of Rainfall and CTD-Ground Water Level

Month	Ground Water Level (cm)	Rainfall (mm)-AWS CENRO Pinukpuk
January	283.70	0.02
February	259.02	0.01
March	232.09	0.01
April	198.28	0.02
May	162.51	0.05
June	142.27	0.12
July	133.94	0.09
August	127.64	0.09
September	135.95	0.10
October	161.88	0.11
November	223.94	0.11
December	229.55	0.10
Average	2077.98	0.09

Figure 6. Correlation of Rainfall and CTD-Ground Water Level



3.4 Air Temperature and Groundwater Temperature

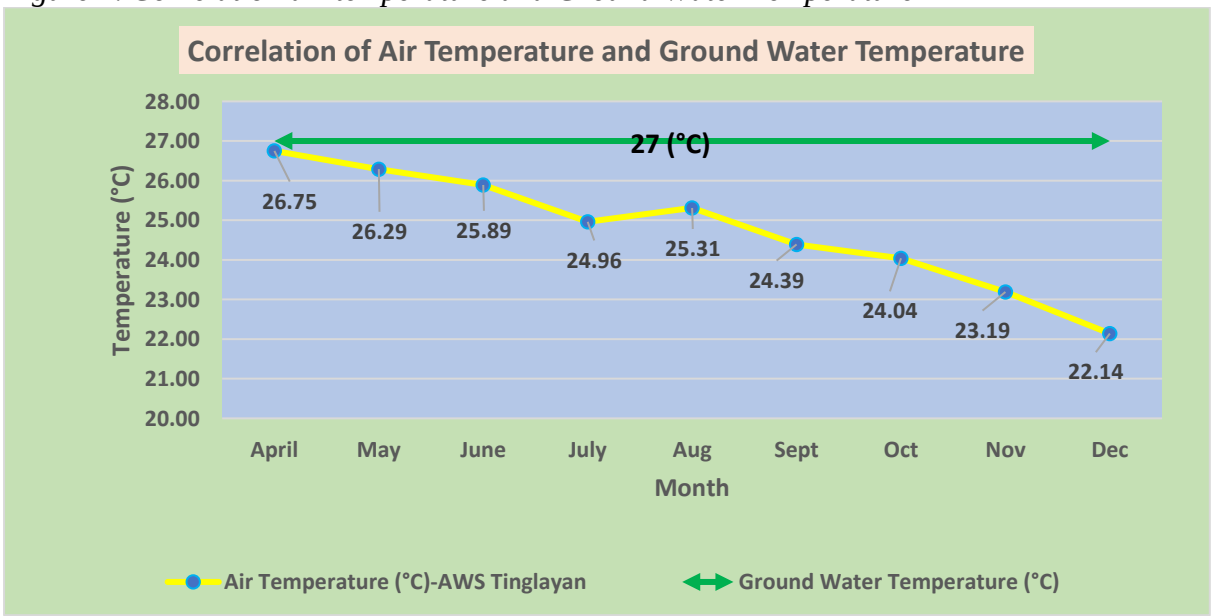
The groundwater temperature, which remains constant at 27 ºC, suggests that it is slightly warmer than the surrounding air. The average maximum temperature recorded by the Automatic Weather Station (AWS) in Tinglayan, Kalinga, was 26.29 ºC during the month of May. This temperature difference indicates ongoing heat exchange between the groundwater and the atmosphere. Typically, it takes some time for changes in air temperature to propagate into the

subsurface and influence groundwater temperatures. The correlation between air temperature and groundwater temperature tends to weaken as one moves deeper into the groundwater system. Several factors, including climate change, local conditions, and seasonal variations, can also affect this relationship. Understanding the correlation between air and groundwater temperatures is valuable for various applications, including groundwater resource management, ecosystem studies, and predicting thermal conditions within aquifer systems. The relationship between air and groundwater temperatures impacts groundwater quality, aquatic ecosystems, species adaptation, water supply management, groundwater storage and recharge, as well as interactions with climate change.

Table 8. Correlation air temperature and Ground Water Temperature

Month	Air Temperature (°C)-AWS Tinglayan	Ground Water Temperature (°C)
January	24.63	27
February	22.52	27
March	23.35	27
April	26.75	27
May	26.29	27
June	25.89	27
July	24.96	27
Aug	25.31	27
Sept	24.39	27
Oct	24.04	27
Nov	23.19	27
Dec	22.14	27
Average	**24.77**	**27**

Figure 7. Correlation air temperature and Ground Water Temperature



III. SUMMARY AND CONCLUSION

This year, the installed watershed instruments within the Chico River watershed—including the AWS, AWLS, CTD-GWS, and Moisture Content Sensors—have been regularly monitored, maintained, and inspected by the relevant field offices (CENROs in Sabangan, Pinukpuk, and Tabuk, as well as PENROs in Mt. Province and Kalinga), along with the DENR-CAR Regional Office. This ongoing oversight ensures that human interference does not lead to the impairment or loss of equipment or instruments, aided by protective fencing and signage to deter malicious intent from the public.

Data consolidation is conducted monthly, with data cleansing implemented to obtain the necessary average values. Focal persons from each CENRO responsible for the monitoring stations submit monthly and quarterly reports as part of their monitoring activities and as necessary Means of Verification for the office. Analysis of the downloaded data revealed inaccuracies in some recorded values, likely due to malfunctioning sensors. Additionally, inaccuracies may arise from unpredictable weather conditions or abrupt climate changes in each area.

Based on the data collected throughout the year, a comparison between the current year (CY 2024) and the previous years (CY 2022 & 2023) indicates that the watershed continues to experience the effects of climate change. Recorded data show a slight decrease in air temperature and solar radiation. Although rainfall events have increased slightly, this has not translated into higher groundwater and streamflow levels; instead, these have decreased, which affects the water resources and supply for local communities, as well as the overall ecosystem of the watershed.

The installation of watershed instruments has enabled the collection of data on stream discharge and meteorological conditions within the Chico Watershed. The data obtained during this period is significant for comparing previous data to identify changes or patterns regarding precipitation, temperature, stream discharge, wind speed, and other variables on a monthly, quarterly, or annual basis. This information serves as a foundation for projecting the future conditions of the watershed, allowing for the identification of cycles and frequencies associated with climatological factors.

IV. FINDINGS AND RECOMMENDATIONS

1. Allocate a spare set of AWS to serve as a substitute during the calibration period of the AWS to ensure continuous data transmissions.

2. The status of one microclimatic sensor of the AWS, specifically the Port 4 VP-4 Sensor installed at Mt. Data in Bauko, Mt. Province, is that it was unable to provide accurate data on the instrument's website after inspection. Therefore, it is recommended to replace it with a new sensor responsible for measuring relative humidity and air temperature in the area.

3. The status of one of the microclimatic sensors of the AWS, specifically the Port 3 ECRN-100 installed at Poblacion, Tinglayan, Kalinga, indicates that it does not transmit data to the website after inspection. Therefore, replacement is recommended for this sensor, which is responsible for measuring precipitation in the area.

4. Conduct capacity-building and hands-on training on the standards, implications, and analysis of data generated from watershed instruments to enhance analysis and visualization.

5. Establish a Memorandum of Agreement (MOA) between DENR, PAG-ASA, and DOST to facilitate easy access to necessary data and coordination related to the Watershed Instrumentation Program.

6. In relation to calibration, it is recommended that a negotiation be conducted with DOST-PAG-ASA for a one-time calibration of the instruments only. This is to prevent the malfunction of the sensors due to regular removal for calibration.

V. ANNEXES

V.1 SUMMARIZED GATHERED DATA OF THE DIFFERENT INSTALLED INSTRUMENTS

A. Automated Weather Station (AWS)

a.1. Automated Weather Station for the Upper Stream

AUTOMATED WEATHER STATION-UPPER STREAM						
Period Covered	Parameter					
	Rainfall (mm)	Air Temperature (^{0}C)	Relative Humidity (%)	Wind Velocity (km/h)	Wind Direction (^{0}/deg)	Solar Radiation (W/m2)
January	0.02	12.47	88.08	4.93	123.91	161.25
February	0.00	15.10	66.16	5.21	137.25	161.25
March	0.00	14.46	81.23	4.82	88.54	188.33
April	0.06	17.19	76.83	4.91	132.35	203.75
May	0.10	16.71	87.96	5.17	128.12	167.43
June	0.12	16.96	89.49	4.66	152.47	181.25
July	0.21	15.99	91.37	6.82	139.24	142.78
August	0.09	16.29	91.25	3.81	124.42	156.79
September	0.24	15.47	94.94	8.02	130.49	93.12
October	0.23	15.41	91.98	8.24	89.71	127.89
November	0.20	15.14	89.62	7.81	109.81	146.93
December	0.05	14.34	96.10	5.61	105.03	119.04
Average	**0.11**	**15.46**	**87.08**	**5.83**	**121.78**	**154.15**

a.2. Automated Weather Station for the Middle Stream

AUTOMATED WEATHER STATION-MIDDLE STREAM						
Period Covered	Parameter					
	Rainfall (mm)	Air Temperature (^{0}C)	Relative Humidity (%)	Wind Velocity (km/h)	Wind Direction (^{0}/deg)	Solar Radiation (W/m2)
January	0.00	24.63	85.51	3.82	126.00	136.48
February	0.00	22.52	80.50	3.49	138.70	156.64
March	0.00	23.35	79.91	3.24	114.80	169.78
April	0.00	26.75	73.08	3.82	167.46	203.33
May	0.00	26.29	79.70	3.22	146.49	173.18
June	0.00	25.89	85.56	2.53	115.18	178.84
July	0.00	24.96	86.22	3.82	116.96	141.05
August	0.00	25.31	85.53	2.61	114.36	183.40
September	0.00	24.39	88.85	1.65	86.21	116.79
October	0.00	24.04	89.02	2.22	105.46	112.23
November	0.00	23.19	91.27	1.91	87.02	96.17
December	0.00	21.54	95.05	0.88	39.57	71.27
Average	**0.00**	**24.41**	**85.02**	**2.77**	**113.18**	**144.93**

*****_The red colored text was the sensor that malfunctioned, thus the data transmitted to the sensor is not accurate_

a.3. Automated Weather Station for the Lower Stream

AUTOMATED WEATHER STATION-LOWER STREAM						
Period Covered	**Parameter**					
	Rainfall (mm)	**Air Temperature (^{0}C)**	**Relative Humidity (%)**	**Wind Velocity (km/h)**	**Wind Direction (^{0}/deg)**	**Solar Radiation (W/m2)**
January	0.02	23.20	89.23	0.86	137.53	106.84
February	0.01	24.99	82.62	1.43	117.03	175.59
March	0.01	25.62	81.39	1.58	132.86	166.24
April	0.02	23.09	88.74	0.87	133.33	112.30
May	0.05	29.59	77.23	1.63	96.93	175.64
June	0.12	27.00	84.69	1.05	93.74	149.86
July	0.09	28.04	87.64	0.84	91.29	137.79
August	0.09	28.32	87.24	0.78	90.05	203.59
September	0.10	26.60	93.90	0.43	87.30	199.63
October	0.11	26.73	93.53	0.80	129.12	137.24
November	0.11	26.01	94.95	0.93	121.28	113.20
December	0.10	23.99	97.86	0.54	158.93	66.88
Average	**0.07**	**26.10**	**88.25**	**0.98**	**115.78**	**145.40**

B. Automated Water Level Station (AWLS)

AUTOMATED WATER LEVEL STATION (AWLS)			
Period Covered	**Streamflow Level (m)**		
	Average	**Maximum**	**Minimum**
January	0.73	0.92	0.36
February	0.52	0.79	0.36
March	0.42	0.74	0.36
April	0.46	1.64	0.24
May	0.80	1.27	0.51
June	0.93	1.8	0.71
July	0.92	2.64	0.58
August	0.99	1.61	0.77
September	1.20	2.29	0.84
October	1.34	4.32	0.87
November	1.42	4.62	0.97
December	1.15	2.84	0.94
Grand Mean	**0.91**	**2.12**	**0.63**

C. Conductivity Temperature and Depth (CTD)-Ground water Sensors

CONDUCTIVITY TEMPERATURE AND DEPTH (CTD)-GROUND WATER SENSORS (GWS)						
Period Covered	Ground Water Level (mm)			Conductivity (mS/cm)		
	Ave	Max	Min	Ave	Max	Min
January	2836.98	2912.00	2743.00	0.87	0.89	0.83
February	2590.19	2759.00	2419.00	0.88	0.89	0.88
March	2320.87	2434.00	2188.00	0.89	0.89	0.88
April	1982.83	2128.00	1811.00	0.88	0.89	0.88
May	1625.14	1828.00	1445.00	0.88	0.90	0.88
June	1422.68	1507.00	1380.00	0.92	0.95	0.89
July	1339.44	1525.00	1147.00	0.95	0.97	0.94
August	1276.40	1320.00	1152.00	0.97	0.98	0.96
September	1359.50	1512.00	1276.00	0.97	0.98	0.96
October	1618.83	1984.00	1464.00	0.94	0.96	0.89
November	2239.41	2510.00	1902.00	0.86	0.89	0.85
December	2295.53	2507.00	2098.00	0.84	0.85	0.83
Grand Mean	**1908.98**	**2077.17**	**1752.08**	**0.90**	**0.92**	**0.89**

D. Soil Moisture Content Sensors

SOIL MOISTURE (%)												
Period Covered	Soil Moisture (%) 5cm			Soil Moisture (%) 10cm			Soil Moisture (%) 20cm			Soil Moisture (%) 30cm		
	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min
January	25.00	3.20	18,7	24.72	39.10	-37.90	2.56	15.40	-14.10	21.49	25.00	15.40
February	14.23	19.00	12.10	43.00	43.00	7.40	12.77	22.50	4.50	13.26	15.50	11.90
March	12.70	12.70	11.00	28.61	43.50	7.50	0.60	10.90	-10.60	11.80	12.40	11.10
April	9.37	10.50	8.30	27.30	39.70	7.20	-10.92	3.10	-27.20	9.60	15.50	8.00
May	16.18	22.10	9.10	21.11	29.90	3.10	-23.93	-14.80	-29.50	12.88	22.70	-42.80
June	25.29	33.30	18.80	6.26	29.40	-28.20	-24.32	0.00	-41.90	15.97	23.70	-1.60
July	24.81	33.60	12.90	-11.60	29.50	-27.00	-31.26	0.00	-42.90	16.51	22.50	-0.10
August	27.66	35.10	22.90	8.61	31.80	-27.30	-30.05	0.00	-41.40	17.00	25.10	-1.20
September	28.72	35.50	22.00	24.11	32.90	7.00	-31.53	0.00	-41.90	15.62	24.50	-2.70
October	29.61	33.90	26.20	25.15	33.30	7.30	-24.10	0.00	-42.40	15.82	24.80	-27.40
November	30.16	33.60	27.30	26.47	29.80	24.30	-18.80	-7.30	-30.90	16.06	25.60	-1.40
December	30.29	33.90	27.70	26.69	30.30	24.70	-16.00	-7.30	-32.00	15.55	22.50	-0.30
Grand Mean	**22.84**	**25.53**	**18.03**	**20.87**	**34.35**	**-2.66**	**-16.25**	**1.88**	**-29.19**	**15.13**	**21.65**	**-2.59**

V.2 BRIEF CHRONOLOGY OF EVENTS

CY 2017

- November 27 to 28, 2017

  - Consultation/orientation on the setting-up of science-based real-time watershed monitoring instruments under the Watershed Instrumentation Program (WIP) conducted by RBCO and WEMS, FMB, and DENR.

  - Identification of priority critical watersheds for the proposed establishment of permanent monitoring sites for instrumentation. Chico River Watershed was identified.

- December 2017

  - Preparation of specifications and budgetary requirements and submission of Annual Procurement Plan for CY 2018.

CY 2018

- March 11 to 16, 2018

  - Orientation training attended by For. Rogelio Dawagui CDD Representative and Ms. Patricia Tayaban, PMD representative at Maramag, Bukidnon. The learning event focuses on the functions and purposes of monitoring instruments and handheld equipment for the establishment of a watershed monitoring system.

- March to June 2018

  - Coordination and orientation regarding the watershed instrumentation program with the CENROs within the jurisdiction of the Chico River Watershed were conducted.

  - Site identification and preliminary site assessment were conducted starting on March 18, 2018. CENRO Sabangan recommends the portion of the old Heald Lumber compound at Sinto, Bauko and an alternate site would be at the TESDA compound at Nacagang, Sabangan. A representative from PENRO Kalinga, For. Eddie Gaayon coordinated with the Mayor of the Municipality of Tinglayan for their approval and identification of a suitable site since the Municipality of Tinglayan represents the middle stream of the Chico River Watershed. Also, CENRO Imelda Casiwan recommends the Military Camp Site located at Malagnat, Pinukpuk and the alternate site for the proposed AWS would be within the CENRO Compound (back of the CENRO building). As for the Automated Water Level Monitoring Station, the best site identified for mounting the instrument is located within the boundaries of the municipality of Tuao, Cagayan, and the municipality of Pinukpuk, Kalinga specifically at the Ninoy Aquino Bridge, Kattabogan-Pinococ-Tuao Road. The identified site is suited for the instrument since 90% of the water passes through this channel and continuously flows to the Cagayan River.

- Proposed sites identified were endorsed to Watershed and Ecosystem Management Section, FRCD, FMB requesting them for further assessment and recommendation by the Watershed Instrumentation Specialist Engr. Bryan Altoveros.

- July 2018

  - Final site assessment and reconnaissance were conducted with the presence of Engr. Bryan Altoveros, FMB Watershed Instrumentation Specialist. The identified proposed sites for the AWS were assessed by Engr. Altoveros considers it the best and most appropriate site since there was no other ideal spot observed within the vicinities of each proposed location considering the security of the apparatus to be installed.

  - As for the AWLS, the proposed site at the Ninoy Aquino Bridge, Pinococ, Pinukpuk was not recommended by Engr. Altoveros. Existing AWLS of the DOST was already installed and was observed that the monitoring station is not functioning due to damage to the metal enclosure and indication of dismantling and theft of the apparatus. As per the map assessment, He then recommends the Canao Bridge located at Calanan, Tabuk, Kalinga as the second option for AWLS. Though there is an existing AWLS installed by the DOST, it was still recommended that the AWLS should be installed on the other distributary portion since the river has two stream discharges.

- September to November 2018

  - Installment delivery of watershed instruments commenced on September 19, 2018, and was completed deliveries on November 26, 2018. Recommended payment amounted to Php 2,697,930.00.

- October 15 to 31, 2018

  - Installation of fence and mounting poles for the AWS was accomplished.

- November 26 to 30, 2018

  - Installation of AWS apparatus and on-site orientation on the basic operations, functionality, care, and maintenance was conducted on each station.

CY 2019

- April 2019

  - Site identification and assessment for the proposed Conductivity, Temperature, and Depth (CTD) groundwater level and Automated Water Level monitoring stations.
  - Site identified for the AWLS is at Canao Bridge, Calanan, Tabuk Kalinga, and for the CTD is at the CENRO Compound. Other sites identified for CTD were assessed to have no connection to the data network, considering that the apparatus must be connected to the required websites providing cloud/database storage.

- November to December 2019

  - Fabrication and installation of metal fence/encasement for the AWLS and CTD.

CY 2021

- March 2021

  - Installation of AWLS and CTD apparatus/sensors was earlier scheduled on the 3rd week of March 2020 but was not continued due to the announcement of the Enhance community quarantine because of the intercontinental spread of the Corona Virus. Travel advisory from Manila to Baguio City and Baguio City to Kalinga province were regularly monitored for the installation activity but unfortunately, passing or entering through barangays and municipalities have limitations with respect to health and safety protocols being issued. Decisions made with the WEMS-FMB personnel were to continue the activity and set a

schedule by the 2nd quarter of CY 2021 if travel is allowed under the new normal situation.

- March 8-12, 2021 – Installation of apparatus was finally accomplished.

- **CY 2022**

  - February 28 to March 4,2022

    Monitoring and maintenance of AWS in Mt. Data, Mt Province through:
    - Cleaning of the Rain gauge, Solar radiation sensor, VP4 sensor disks/plates
    - Weeding around the ground fence/instruments
    - Repainting of guard fence of the instruments

- September 2022

The Regional staff delivered and installed the signages for the Automated Weather Station, Automated Water Stations, and CTD-Ground Water Station. The signage for AWS at the middle stream was delivered but not installed because the proposed site for the station is still under construction.

However, the Municipal Administrator committed that after completion of the RHU building, poles for the AWS shall be made for the instruments to be mounted permanently.

- October 24 to 28, 2022

  - Monitoring and maintenance of AWS, AWLS, and CTD through:
  - Dismantling of three (3) units of AWS in Upper Stream (Mt. Data), Middle Stream (Poblacion Tinglayan), and CENRO Pinukpuk compound.
  - Cleaning of Rain Gauge, Solar radiation sensor, VP4 disks, Anemometer, and Cloud-base data logger using dry clothes;
  - Weeding around the instruments.

- October 11, 2022

The Regional Office submitted the accomplished Incoming Instrument Form (IIF) dated October 11, 2022, to the Department of Science and technology-Philippine Atmospheric Geophysical and Astronomical Services Administration (DOST-PAGASA) to process the calibration of installed three (3) AWS within Chico River.

After this, the dismantling of the AWS was successfully accomplished on November 9, 2022, and subsequently delivered the instruments to PAGASA- DOST Calibration Laboratory for calibration on December 2022. Data Generation/transmission ceased automatically upon dismantling. As per PAGASA, the calibration period will likely be completed in March 2023, and data generation/transmission shall resume by the n.

CY 2023

- April 17 to 21, 2023

  - Reinstallation of the calibrated parameters of three (3) Automated Weather Station (AWS) at Mt. Data, Bauko, Mt. Province, Poblacion, Tinglayan, Kalinga and CENRO Pinukpuk, Kalinga and Sim card replacement of one (1) Automated Water Level Station (AWLS) at Canao Bridge, Calanan, Tabuk City, Kalinga was conducted with the Staff of the Forest Management Bureau (FMB) under the Forest Resources Conservation Division (FRCD) and the focal persons/staff of the field offices (CENRO Sabangan, PENRO Kalinga, CENRO Pinukpuk and CENRO Tabuk).

  - The FMB staff also conducted orientation on the Watershed Instrumentation Program (WIP) to the concerned CENRO's, PENRO's and the LGU of Tinglayan, Kalinga.

Orientation at CENRO Sabangan and reinstallation of the AWS at Mt. Data, MP

Orientation of LGU Tinglayan, kalinga and reinstallation of the AWS

Sim card replacement of AWLS at Canao Bridge, Tabuk City, Kalinga

Maintenance of CTD-GWS, Reinstallation of the AWS and Orientation at CENRO Pinukpuk, Kalinga

- June 13 to 16, 2023

  - Conducted Monitoring and maintenance of the installed instruments on June 13-16, 2023. The purpose of the travel was to check and assess the status of the installed instruments. Also, to coordinate with the Local Government Unit of Tinglayan, Kalinga regarding the Memorandum of Agreement between the DENR-CAR and Tinglayan, Kalinga on the protection, maintenance, and data access of the installed Automated Weather Station within the roof deck building of the Rural Health Unit of Tinglayan.

Checking and Monitoring of the AWS at Tinglayan, Kalinga

- October 17 to 20, 2023

  - Conducted Monitoring and maintenance of the installed instruments. The group checked and cleaned the microclimate sensors: the VP4 disks, VP4 sensors, anemometers, rain gauge, solar radiation sensor, water level sensors, and data loggers of the instruments, monitored the parameters of the instrument and conducted weeding around the area. The signage of the AWS at Tinglayan, Kalinga was installed and the Memorandum of Understanding was also signed by the Municipal Mayor of Tinglayan, Kalinga and a copy was given for the DENR-CAR, Regional Office.

Checking, monitoring and maintenance of the AWS at Mt. Data, Bauko, Mountain Province

Checking, monitoring and Installation of the signage of the AWS at Tinglayan, Kalinga

Checking, monitoring and maintenance of the AWS and CTD-GWS at CENRO Pinukpuk, Kalinga

CY 2024

- April 16-19, 2024

  - Conducted monitoring and maintenance of the installed AWS at Mt. Data., Bauko, Mountain Province. The group conducted cleaning, brushing along and within the instrument perimeter fence. Iron works was also conducted such as cutting, welding and grinding to install a ladder to the installed AWS for easier access.

Cleaning, brushing along and within the instrument perimeter fence:

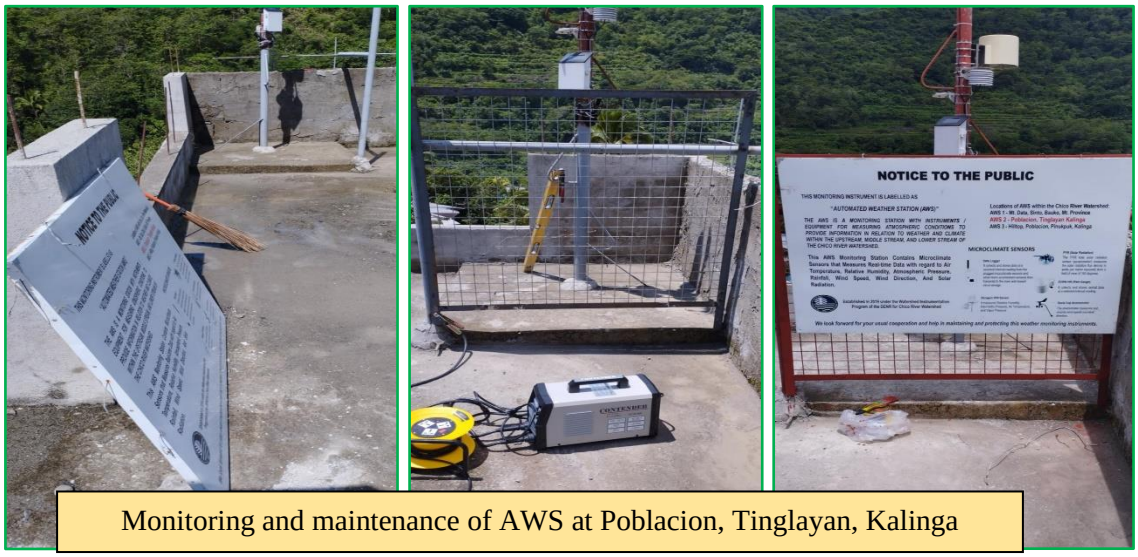
Activities conducted in the installation of the ladder:

Monitoring and maintenance of AWS at Mt. Data, Bauko, Mountain Province

- June 4-7, 2024

  - Conducted monitoring and maintenance of the installed AWS at Poblacion, Tinglayan, Kalinga. The purpose of the travel was to check and assess the status of the installed instrument. The team conducted also iron works to install the perimeter fence of the instrument to secure and protect it.

Activities conducted in the installation of the perimeter fence:



Monitoring and maintenance of AWS at Poblacion, Tinglayan, Kalinga

- October 22-25, 2024

  - Conducted monitoring and maintenance of the installed AWLS at Canao Bridge, Calanan, Tabuk City, Kalinga and AWS at CENRO Pinukpuk Compound, Kalinga. The group checked and cleaned the microclimate sensors, monitored the parameters of the instrument and conducted weeding around the area.

Monitoring and maintenance of the installed AWS and AWLS:

Monitoring of the AWLS at Canao Bridge, Tabuk City, Kalinga

Maintenance of the CTD Groundwater Sensors and AWS at CENRO Pinukpuk, Kalinga

V.3 MEMORANDUM OF UNDERSTANDING (MOU) BETWEEN DENR-CAR AND LGU OF MUNICIPALITY OF TINGLAYAN, KALINGA

MEMORANDUM OF UNDERSTANDING

"INSTALLATION, MAINTENANCE, AND PROTECTION OF AUTOMATED WEATHER STATION (AWS) IN RELATION TO THE IMPLEMENTATION OF THE SCIENCE-BASED REAL-TIME WATERSHED INSTRUMENTATION WITHIN CHICO WATERSHED"

KNOW ALL MEN BY THESE PRESENTS:

This Memorandum of Understanding is made and entered into by and among:

The **DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES- CORDILLERA ADMINISTRATIVE REGION**, with office address at Foresty Compound, Gibraltar Road Baguio City, represented herein by its Regional Executive Director **ENGR. RALPH C. PABLO, DPA, En.P, CESO III** hereinafter referred to as the **"DENR-CAR"**

- and -

The **LOCAL GOVERNMENT UNIT** of the Municipality of Tinglayan, with office address at Poblacion Tinglayan Kalinga, represented by its Municipal Mayor, **HON. SACRAMENT S. GUMILAB** hereinafter referred to as the **"SECOND PARTY"**.

WITNESSETH THAT:

WHEREAS, it is the policy of the state as embodied in the 1987 Philippine Constitution to promote and advance the right of the people to a balanced and healthful ecology in accord with the rhythm and harmony of nature;

WHEREAS, the **DENR** is mandated under E.O. No. 192 and the Local Government Code to be the primary government agency responsible for the conservation, management, development, and proper use of the country's environment and natural resources, specifically forest and grazing lands, mineral resources, including those in reservation and watershed areas and lands of the public domain, as well as the licensing and regulation of all natural resources as may be provided for by law in order to ensure equitable sharing of the benefits derived therefrom for the welfare of the present and future generations of Filipinos;

WHEREAS, the **DENR** is mandated under E.O. No. 192 Section 17 (d) to generate technologies and provide scientific assistance in the Research and Development of technologies relevant to the sustainable uses of Philippine Ecosystems and Natural Resources;

WHEREAS, the **DENR** spearheaded the watershed management and development of Chico Watershed and to this effect installing other relevant instruments to gather data to generate more information on the proper management of the watershed.

WHEREAS, the **DENR** shall install a one-unit Automated Weather Station (AWS) at Poblacion Tinglayan as part of the instrumentation of the above-mentioned project;

WHEREAS, The **MUNICIPALITY** realizes the urgent need to manage its natural resources and environment to sustain its short, medium, and long-term socioeconomic development;

WHEREAS, The **MUNICIPALITY** have committed to assist the DENR in providing assistance in securing the instrument from thieves and vandalism;

NOW THEREFORE, for and in consideration of this Memorandum of Understanding and mutual covenants and stipulations hereinafter set forth, the parties have agreed to recognize and undertake the following:

ARTICLE I – PURPOSE

Section 1. This Memorandum of Understanding expresses full knowledge and agreement concerning the responsibilities of the parties with regard to the installation, maintenance, and protection of Automated Weather Station (AWS) for the instrumentation as part of the project of watershed management;

Section 2. AWS is a solar-powered set-up composed of a rain gauge and microclimate sensors for air temperature, relative humidity, soil moisture, wind speed, and wind direction and are connected to a remote data acquisition unit with non-volatile memory capable of storing approximately one year of data, two independent high capable rechargeable lithium polymer battery, satellite, and GSM module capable of sending meteorological data in every ten-minute interval;

Section 3. This instrument is intended for baseline information generation following a standardized characterization and instrumentation technique and will serve as a venue for the collection and monitoring of key watershed resources and services for the long-term watershed database in support of science-based policy and management decision-making; and

Section 4. The device monitors real-time or on-site data storage, consumes low power, transmits data automatically, and is low maintenance.

ARTICLE II- ROLES AND RESPONSIBILITIES OF THE PARTIES

Section 5. The **DENR** is hereby vested with the following roles and responsibilities:

5.1 Provide the Automated Weather Station (AWS) as well as the manpower and technical expertise in the installation of the above-mentioned instrument;

5.2 Install the instrument using a fabricated steel post/fence preferably in an open area with minimal obstructions (i.e. building, trees, etc.) and with consistent signal reception;

5.3 Ensure the security of the AWS by constructing a fence to protect the equipment;

5.4 Shoulder the expense with respect to the monthly post-paid SMS service as well as the maintenance of the equipment;

5.5 Capacitate the focal person/LGUs on technical matters and the importance of Database management of AWS;

5.6 Endeavor to educate the people of Tinglayan, especially the community living near the watershed and its impact on the people;

5.7 Discharge such other functions, duties, and responsibilities as may be necessary to carry out the objective and purpose of this MOU.

Section 6. The **MUNICIPALITY** is hereby vested with the following roles and responsibilities:

6.1 Consent to the installation of the one-unit Automated Weather Station (AWS) established within the roof deck of the Rural Health Unit (RHU) building at the municipal hall compound Poblacion, Tinglayan;

6.2 Safeguarding and securing the instrument from any unlawful activities such as robbery and vandalism;

6.3 Report immediately to the **DENR** any incident that may be prejudicial to the security and proper functioning of the equipment;

6.4 Access viewing of all data from the instruments through the website using the access code given by the DENR Central Office, provided that said access code should not be disclosed to persons other than herein parties.

6.5 Provision of financial allotment for the maintenance and protection of the monitoring station.

6.6 Endeavor to educate the people of Tinglayan, especially the students and communities living along the vicinities of the Chico River Watershed about the importance while maintaining a healthy watershed and its impact on the people of Kalinga and

ARTICLE III – SEPARABILITY CLAUSE

Section 7. If any part or provision of this Memorandum of Understanding is held invalid or unconstitutional, other provisions not affected thereby shall remain in force and effect.

ARTICLE IV – EFFECTIVITY AND OWNERSHIP

Section 8. This Memorandum of Understanding shall take effect immediately upon signing hereof by the parties and shall remain in force for the duration of the project unless otherwise revoked or cancelled by the **DENR.** However, in case this Memorandum of Understanding shall be terminated, revoked, or cancelled by the **DENR,** the ownership of the instrument/equipment including its improvements installed herein shall remain the property of the Government and shall be returned to the **DENR.**

IN WITNESS WHEREOF, the parties hereunto set their hands this 11 JUL day of 2023 2023 at CITY OF BAGUIO Philippines.

For the FIRST PARTY:

ENGR. RALPH C. PABLO DPA, En.P., CESO III
Regional Executive Director

For the SECOND PARTY:

ATTY. SACRAMENTO S. GUMILAB
Municipal Mayor

WITNESSETH BY:

NOEL M. BARRIENTOS
PENRO Officer, PENRO Kalinga

ROGELIO M. TAMBALONG
Municipal Vice-Mayor

IMELDA CASIWAN
CENR Officer – Tabuk

JERRY M. SO-ANG
SB Chair on Environment

BENEDICTO L. DALIGNOC
MDRRMO-Tinglayan

HOLY M. BALLA-AO
DOH-Tinglayan

ACKNOWLEDGEMENT

REPUBLIC OF THE PHILIPPINES)
CITY OF CITY OF BAGUIO) S.S

BEFORE ME, a Notary Public, for and in the above jurisdiction, personally appeared the following:

NAME	COMPETENT EVIDENCE OF IDENTITY
SACRAMENT S. GUMILAB	TIN: 411-230-097-000

Known to me to be the same persons who executed the foregoing Memorandum of Understanding and acknowledge to me that the same is their own, free, and voluntary act and deed as well as the entities they represent.

This Memorandum of Understanding consists of five (5) pages including this page wherein this Acknowledgement is written and is signed by the parties and their instrumental witnesses on each and every page hereof.

WITNESS MY HAND AND SEAL this ___day of 11 JUL 2023, 2023 at CITY OF BAGUIO.

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Book No. IV
Series of 2023;

Atty. EDELCRIST B. KANITENG-TEOFILO
Notary Public for Baguio City
Until December 31, 2024
NA-166-NC-22-R; Baguio City
PTR No. 5982751; 01-10-23; Baguio City
IBP O.R. No. 29869; 01-01-23; Baguio-Benguet Chapter
Roll No. 69727; June 1, 2017
55-A Luna St., Purok 7, Apugan, Irisan, Baguio City

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OIC-Chief, CDD

Noted by:

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OIC-ARD for Technical Services

ENGR. PAQUITO T. MORENO JR., CESO III
Regional Executive Director