

Operation and Maintenance (O&M) Plan – Hydromet installations

Operations & Maintenance (O&M) of the installed hydrometeorological infrastructure will need to be pursued through a wide range of approaches, recognizing that no single approach is likely to be able to provide all the required resources. Approaches can include the leveraging of domestic resources (government budget allocations), capacity building (human and financial planning) for regular/sustained O&M, and exploring private sector partnerships to operationalise and provide financial returns from the generation of climate information and associated advisories. Domestic resource allocations and provision of training for O&M can enable country ownership and strengthen the mandates of MSD and ZinWA, which will help them to negotiate future increases in allocated domestic finances and commitments, which in turn strengthens the long-term viability of established infrastructure. Maintenance and service contracts (for 3 years) should be bundled in procurement notices for the supply of all hydrometeorological equipment, beyond which O&M will be provided by MSD and ZinWA through their budget allocations, including the following which have been discussed and agreed upon:

- Total co-financing in cash from GoZ is USD **113,900** of which,
 - USD **74,600** from MSD includes O&M of AWS, automatic and manual rain gauges for the seven years duration of the project; and
 - USD **39,300** from ZinWA includes O&M of automatic water level/streamflow gauges for the seven years duration of the project;
- Total post project O&M in cash commitment from GoZ is estimated at USD **145,000** of which
 - USD **84,000** is from MSD; and
 - USD **61,000** is from ZinWA

Embedded within the proposal cost estimates are allowances for spare parts (bought during the final two years of the project) which will be used after the project and service/maintenance contracts end, and the cost of O&M for each year. It is critical that MSD and ZinWA invest in enhancing both staff capacity and numbers, which will allow these agencies to provide O&M services beyond the project time frame for the expanded networks of observing infrastructure. These agencies have also committed to undertake replacement of equipment through budget investments.

The project can support capacity building to ensure that required technical capabilities and human resources are sustained for O&M beyond the project lifetime. Specifically, the project includes:

- Training for technicians at MSD and ZinWA to operate & maintain the installed AWS, hydrological water level/gauging stations, associated telemetry systems and undertake the regular calibration of sensors;
- Ensuring the procurement agreements with suppliers of equipment includes training by the supplier, at least at one or two selected sites. This will enhance technicians' understanding of the operation and maintenance of the equipment being installed.
- Where possible, after sales service contracts for the lifetime of the project will be negotiated, ensuring spare parts are available beyond the project lifetime.

Automatic Weather stations and equipment:

The installation and maintenance of automatic weather stations in the Meteorological Services Department (MSD) is undertaken by the Engineering Unit. The department has established three distinct levels of maintenance:

- Preventive maintenance – this involves replacing or overhauling worn and/or obsolete parts of the AWS at predefined time intervals based on the lifespan and technology of the component. MSD carries out preventive maintenance quarterly by qualified technicians;

- Corrective maintenance – technicians are required to correct a failure that has occurred or is in the process of occurring. This activity consists of repair, restoration or replacement of components. The interval for this is when the fault occurs.
- Calibration – AWS sensors with electrical outputs, show accuracy drifts in time and, consequently, need regular inspection and calibration. This involves travelling to the AWS site and determining the performance parameters of the AWS sensors by comparing with standard measurements and thereafter making appropriate adjustments or replacing sensors. Calibration is undertaken annually.

Besides the maintenance cost, MSD plans for costs of data transmission using GPRS mobile technology from each AWS to a central database and display system based at MSD headquarters. Typical annual O&M costs for different types of stations are:

Station	Purchase Cost (US\$)	Annual Costs of Operating & Maintenance for each station (US\$)
Manual	5,000	500
Synoptic	30,000	1,000
Agromet	10,000	700

Hydrological monitoring equipment and infrastructure:

Surface water monitoring (telemetric stations): One of ZinWA's core functions is ensuring that its hydrometric stations are functioning and properly maintained. For the 10 gauging stations across the 3 catchments that will be upgraded under the project, ZinWA will continue to maintain them as part of its country-wide obligations. In terms of O&M ZinWA has resources at both the provincial/catchment office and at the field station level, including:

Provincial/Catchment office: 1 Hydrologist, 1 Mechanician + 2 technicians

Human resources will be covered through ZINWA. One of the main problems is a lack of vehicles to attend to repairs and routine maintenance. Some vehicles at head office are used for O&M of gauging stations across the country. However, at catchment level there are no dedicated vehicles. Pool vehicles are currently being used, which are shared amongst all the departments, resulting in delays in attending to repairs and maintenance. ZINWA is prepared to guarantee the maintenance of any project vehicles but is aware that a vehicle may not be possible to procure with GCF funds.

Field station level: 1 hydro-observer covers 1-3 stations depending on distances

Human resources and O&M will be covered through ZINWA. The salary of a field station observer is 500 USD/month. Given the extra stations to be procured through the project it will be necessary to employ an extra 6-8 observers (2 Runde, 2-3 Save, 2-3 Mzingwane). Additional costs include: motorbikes for transport and fuel for motorbikes is approximately 20 L/month; data loggers need \$1 airtime per month; batteries need to be changed every 4-5 years, but data loggers are expected to last 10-15 years. The project is expected to contribute to: rehabilitation of existing and new stations; motorbikes (USD 2,500 each) or vehicles for the 6-8 field observers.

O&M costs and schedule

The table below indicates the resources that can be made available for O&M activities for the 7 years of the project and post project for the 10 following years, based on committed domestic co-financing and GCF funding. This would cover the expected lifetime of the equipment assuming it was installed in year 1. Where equipment is installed in years 2 and 3 the timeframe will shift accordingly (including bundled service and maintenance contracts), but still incorporate provision for purchasing spare parts before the project ends. Funds for years 1 & 2 will still be required to allow for site visits and planning of infrastructure rollout (including vehicle maintenance), as well as to purchase tools and equipment for maintenance etc.

The O&M budget will need to be refined during project implementation, based on a more detailed examination of current human and financial resources, as well as an accurate estimate of the required costs needed to service the equipment. The costs of developing a long-term strategy for O&M, is provided for during the first two years, and the strategy will be reassessed towards the project completion (final two years). The budget assumes that GCF resources will need to finance the tools, equipment and travel for O&M initially, with a decreasing contribution towards the end of the project lifetime, after which domestic financing will take over. Assuming that, for the first three years after equipment installation, spare parts are covered through bundled maintenance contracts with suppliers, it is suggested that the final two years of GCF funding are used to buy spare parts to last beyond the lifetime of the project – assuming no service/maintenance contract is in place for this period. There may yet be requirements for spares and so this has been included under domestic financing at a lower rate (to take up any extra requirements). Training for O&M will be funded through GCF resources for the lifetime of the project and will not be needed after it finishes.

O&M for Climate Information Systems								Total project duration cost (US\$)
Equipment	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	
Automatic weather stations and raingauges*								
Domestic financing from MSD budget: Spare parts, accessories, internet bundles				4,200	8,400	8,400	8,400	29,400
Domestic financing from MSD budget: Human resources & travel, fuel and vehicle maintenance				12,000	24,000	24,000	24,000	84,000
GCF: Spare parts, accessories, internet bundles			8,400	4,200				12,600
GCF: Human resources, travel, fuel			24,000	12,000				36,000
GCF: Training for MSD for O&M of AWS and raingauges		12,500	12,500		12,500			37,500
Total costs, of which:								0
Domestic financing from MSD budget: Cumulative costs	0	0	0	16,200	32,400	32,400	32,400	113,400
GCF: Cumulative costs (including training)	0	12,500	44,900	16,200	12,500	0	0	86,100
Automatic hydrological stations#								0
Domestic financing from ZinWA budget: Spare parts, accessories, internet bundles				3,000	6,000	6,000	6,000	21,000
Domestic financing from ZinWA budget: Human resources, travel, fuel and vehicle maintenance		50,880	50,880	54,380	57,880	57,880	57,880	329,780
Refresher trainings for O&M of hydrological equipment						12,500	5,800	18,300

Domestic Financing from Zinwa: Data logger air time for 10 hydro stations								0
GCF: Spare parts			6,000	3,000				9,000
GCF: Human resources & travel (fuel and vehicle maintenance)			7,000	3,500				10,500
GCF: Training for ZinWA for O&M of hydrological equipment		12,500	12,500		12,500			37,500
GCF: Data logger air time for 10 hydro stations		100	100	100	100	100	100	600
GCF: 10 new batteries in year 5					1,000			1,000
Total costs, of which:								0
Domestic financing from ZinWA budget: Cumulative costs	0	50,880	50,880	57,380	63,880	76,380	69,680	369,080
GCF: Cumulative costs (including training)	0	12,600	25,600	6,600	13,600	100	100	58,600
Other O&M costs								0
Domestic financing from MSD for MSD and AGRITEX Frontline SMS server systems - building on existing systems @ \$20,000 over 6 years		7,600	7,600	7,500	7,500	7,500	7,500	45,200
Total combined costs, of which:								0
Domestic financing from MSD budget: In cash	0	7,600	7,600	11,700	15,900	15,900	15,900	74,600
Domestic financing from MSD budget: In kind	0	0	0	12,000	24,000	24,000	24,000	84,000
Domestic financing from ZinWA budget: in cash	0	0	0	3,000	6,000	18,500	11,800	39,300
Domestic financing from ZinWA budget: in kind	0	50,880	50,880	54,380	57,880	57,880	57,880	329,780
GCF: Cumulative costs (including training)	0	25,100	70,500	22,800	26,100	100	100	144,700



* MSD: Require extra 3 people trained from current staff for period of 2 years to cover extra equipment (no extra human resource costs) – GCF funds used for training;
ZinWA: O&M is done by a team based at each catchment. The team is headed by a Hydrologist who is responsible for downloading data and calibration of the equipment and a Mechanician who does the servicing of the equipment. The Mechanician is assisted by two technical assistants. An extra 6 observers will be employed by ZinWA (through domestic financing), at an annual cost of USD 36,000.

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