UWR Rainwater (RoU) Standard

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Concept & Design: Universal Water Registry

www.uwaterregistry.io

The objective of this Universal Water Registry Rainwater Offset Unit Standard (UWR RoU Standard or Programme) is to drive unutilized water harvesting, recharge and conservation efforts, defined as the actions taken for capturing/recycling/reusing unutilized sources of water that is socially and culturally equitable, environmentally sustainable and economically beneficial, achieved through on site or catchment project activities. Building capacity and removing barriers to accessing finance is fundamental to accelerate climate change adaptation.

Users of this methodology understand their own water use, catchment context and shared concerns in terms of water governance; water balance; water quality; Important Water-Related Areas (IWRAs); Water, Sanitation and Hygiene (WASH), and then engage in meaningful individual and collective actions that benefit people, the economy and nature. In all project activities under this methodology, the end use of the water must either be consumption, utilization, recycling with gainful end use, groundwater recharge or protection of freshwater related ecosystems.

The UWR RoU Standard challenges the notion of using hydrological basins as the basic organizational focus and looks at how water (and other vectors) actually move — a view that suggests that a "water harvesting/conservation/recharge system" could be a city, an ecosystem, a farmer's field or a factory setting within closed boundaries. As observed and documented in various studies, water security plans need to consider a new approach that includes water resources on ground and underground. Communities most often do not make the connection between surface and ground water.

The UWR RoU programme has direct people's involvement in planning and management of water at the local level giving them ownership over their natural resources to create water security plans which is at the crux of any demand-driven approach to water conservation which . This is at variance with the supply-driven approach where communities are mere receivers of water supply.

In simpler systems, the hydrological basin may or may not be the "system" in many places or won't be in the near future. A hydrological-only focus obscures or confuses what is actually happening within the project boundary (e.g. aquifers, often exist in recharge and discharge basins that have complex relationships with what is happening on the surface with rivers and lakes).

Ground water usage laws and their enforcement has been poor in India. The policies do not reach the end users who are expected to be key stakeholders, in a way they would understand its provisions and their role. In the absence of a withdrawal strategy in projects, the water users slip back to their original condition, which is a strain on resources spent by the government. Many a times, the policy imperatives for convergence get lost in achievement of targets at the local level. There is limited promotion of available technologies like the GIS and remote sensing, where water security plans encompassing a watershed have been made for a large number of villages. Yet the water security concept in its true sense has not become institutionalized enough.

The UWR RoU programme and methodology employs a broad monitoring and accounting framework that is expected to capture the impacts of various water recharging, harvesting, recycling and conservation practices aimed at unutilized water savings and enhancing groundwater supply stocks. Projects may apply a combination of practices as set out in this document.

While this program was developed for India and Asia, countries and regions outside Asia, will also be considered into the program taking the spirit (goal) of UN SDG 17 into account, especially water conservation and recharge projects that encourage and promote effective public, public-private and civil society partnerships while building on the experience and resourcing strategies of such partnerships. The UWR RoU Standard respects every country's policy and leadership space that establishes and implements policies for sustainable water and groundwater development. We also recognize that the unfolding water crisis is universal.

The UWR RoU Standard treats water as a community asset. Therefore, support to community via water credits, including that for capacity building at different levels is provided. Water credits (RoUs) serve as incentives to support behavior change in favour of sustainable water use and management at various levels.

Background

Water is an essential pillar of sustainable development. Water resources and ecosystems provide food (SDG 2) and energy security (SDG 7), contribute to human and environmental health (SDG 3), and are essential for manufacturing industries (SDG 9). Integrated water resources management can contribute to tackling poverty (SDG 1) and inequality (SDG 10), enhance economic development (SDG 8), develop urban settings (SDG 11) and support the protection of ecosystem services (SDGs 6 for freshwater, 14 for marine and 15 for terrestrial). Yet, the sustainability of water-related ecosystems is threatened by climate change (SDG 13), excessive pollution (SDGs 6 and 14) and overexploitation. Hence the need to reduce deteriorated water quality and water scarcity and avoid water-related conflicts (SDG 16) as well as regulate consumption and production (SDG 12) for future generations. Additionally, given the interlinkages of the water sector with all aspects of national economies, policy coherence is crucial to ensure synergy and avoid trade-offs between and among economical activities.

Global events and examples have highlighted both the potential implications of water scarcity and the pathways to achieve water security. Recently, the worsening water crisis in Cape Town, South Africa, where the city hovered dangerously close to 'Day Zero' (when it could run out of water), had caused water rationing and civil strife in the city in 2018, combined with the global examples of countries managing water effectively in a long-term sustainable manner, such as that of Israel, have ensured that the momentum around effective water management has been increasing and that the sector is being accorded a high priority in the national policy agenda of countries.

Roughly half of the world's population currently experience severe water scarcity for at least some part of the year due to climatic and non-climatic drivers Risks in physical water availability and water-related hazards will continue to increase by the mid-to long-term in all assessed regions across the world, with greater risk at higher global warming levels. In small islands, groundwater availability is threatened by climate change. Changes to stream flow magnitude, timing and associated extremes are projected to adversely impact freshwater ecosystems in many watersheds by the mid-to long-term across all assessed climatic scenarios. At global warming of 4°C, approximately 10% of the global land area is projected to face increases in both extreme high and low river flows in the same location, with implications for planning for all water use sectors. Challenges for water management will be exacerbated in the near, mid and long term, depending on the magnitude, rate and regional details of future climate change and will be particularly challenging for regions with constrained resources for water management (*source: IPCC WGII Sixth Assessment Report 2022*).

Over 40% of Europe's water footprint lies outside its border, and 50% of the UK's footprint is from unsustainable sources. The moral case for rapid action to ensure that our water footprint is sustainable and resilient is clear, and this action can only succeed in partnership with producer countries and through engagement with companies.

While this program and standard is aimed at all unutilized water conservation and recharge efforts (with or without treatment) worldwide, its genesis lies in India and hence, the protocol established by the Universal Carbon Registry (UWR) keeps projects established within India in mind as the basis of development and standardisation of this methodology associated with the program.

This methodology also addresses Managed Aquifer Recharge (MAR) processes, defined as a holistic approach to various groundwater recharge methods including artificial recharge, aquifer recharge and rainwater harvesting. This term is widely used in water polices and official papers in recent times. MAR under this methodology also refers to water conservation, wastewater recycling and desalination projects.

There is a general acknowledgment that humanity's Carbon Footprint (CF) and Water Footprint (WF) have surpassed sustainable levels and that society must make efforts to reduce them, but it appears to be quite difficult to establish unambiguous and agreed upon maximum sustainable levels for WFs. **Hence, this methodology and protocol is aimed at the voluntary water conservation market and addresses the potential to quantify unutilized water units from water conservation, harvesting, restoration and recharge projects.** Asia has achieved impressive growth in economic and social welfare during the last decades. Good water management and human capital development remain vital to support economic growth and increase overall social wellbeing in Asia and the Pacific, especially after the coronavirus disease 2019 (COVID-19) pandemic. Despite the achievements in Asia and the Pacific (home to 60% of the world's population), 1.5 billion people living in rural areas and 0.6 billion in urban areas still lack adequate water supply and sanitation (source: AWDO 2020).

Environmentally conscious consumers from water-rich regions of the world pay more attention to their indirect water consumption embodied in the goods they consume (e.g. cotton for jeans or coffee) than the direct water usage, which in relative terms, may have a much smaller environmental impact. **Rainwater offset Units (**RoUs) as envisioned under this Standard, are generated for water that can be harvested repeatedly with negligible environmental impacts – a condition that is analogous to sustainable water use.

Take a single T-shirt for example. It takes 712 gallons of water to produce one, mostly because of the water needed to grow the cotton. A quarter-pound hamburger requires 462 gallons of water if you take into account the water required to grow the cattle feed (source).

Today India is a water stressed nation, standing on the brink of an acute water crisis: a fact that can be seen in its per-capita water availability which is less than 1,500 cubic meters a year.

Water, the very element that supports life, seems to be drying out of this country. Hence, it's more important than ever before to provide an incentive to conserve water and various recharging methods, both traditional and modern, that help conserve the unutilized water resources in India. First, an incentive directly encourages conservation of water. Second by creating a price for water, it can visibly demonstrate the effects of saving it. If a conserver can trade their water savings for cash, they will be much more likely to invest in conservation technologies and better yet, encourage other parties to undertake similar initiatives.

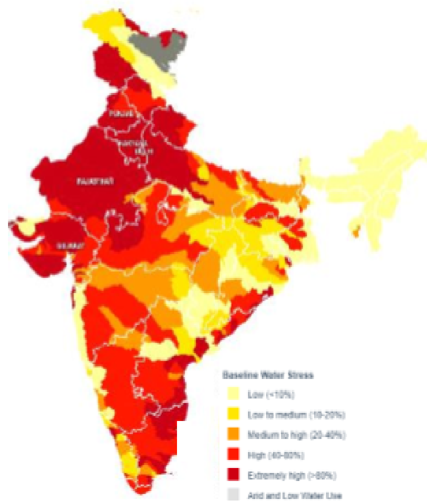
There is no clear relationship between water's price and its value, the price often reflects attempts for cost recovery and not the value delivered. There is also no real incentive to recharge groundwater or install rainwater harvesting systems at a scale needed to address the current water crisis.

India is suffering from the worst water crisis in its history and millions of lives and livelihoods are under threat. Currently, 600 million Indians face high to extreme water stress and about two lakh people die every year due to inadequate access to safe water. The crisis is only going to get worse. By 2030, the country's water demand is projected to be twice the available supply, implying severe water scarcity for hundreds of millions of people and an eventual ~6% loss in the country's GDP. As per the report of National Commission for Integrated Water Resource Development of MoWR, the water requirement by 2050 in high use scenario is likely to be a milder 1,180 billion m3 (BCM), whereas the present-day availability is 695 BCM. The total availability of water possible in country is still lower than this projected demand, at 1,137 BCM. Thus, there is an imminent need to deepen our understanding of our water resources and usage and put in place interventions that make our water use efficient and sustainable (*source: Composite Water Management Index (CWMI), 2018*).

RoUs, serve as an important tool in rebalancing the water dynamics of the region by incentivizing and monetizing all efforts to harvest and conserve rainwater and to methods that recycle and/or reuse wastewater and/or to projects that convert an unutilized water source into usable water. The establishment of RoUs leads to a water-rich environment.

India is undergoing the worst water crisis in its history. Already, more than 600 million people[13] are facing acute water shortages. Critical groundwater resources – which account for 40% of our water supply – are being depleted at unsustainable rates.

Figure 6: Baseline water stress in India[14,15,16]
Ratio of total withdrawals and total flow (2010)



Facts: Water supply is limited, quality is poor

600 million people face high-to-extreme water stress.

75% of households do not have drinking water on premise. **84%** rural households do not have piped water access.

70% of our water is contaminated; India is currently ranked 120 among 122 countries in the water quality index.

Droughts are becoming more frequent, creating severe problems for India's rain-dependent farmers (~53% of agriculture in India is rainfed[17]). When water is available, it is likely to be contaminated (up to 70% of our water supply), resulting in nearly 200,000 deaths each year[18]. Interstate disagreements are on the rise, with seven major disputes currently raging, pointing to the fact that limited frameworks and institutions are in place for national water governance[19].

Source: Niti Aayog, 2018

The assessment of ground water extraction in India is typically carried out considering the Minor Irrigation Census data and sample surveys by the State Ground Water Departments. The Total Annual Ground Water Extraction of the entire country for the year 2017 has been estimated at 248.69 bcm. The agriculture sector is the predominant consumer of ground water resources. About 89% of total annual ground water extraction i.e. 221.46 bcm is for irrigation use. Only 27.24 bcm is for Domestic & Industrial use, which is about 11% of the total extraction. In the states of Arunachal Pradesh, Delhi, Goa, Jammu & Kashmir, Kerala, Mizoram, Nagaland, Sikkim and Tripura and Union Territories of Andaman & Nicobar Island, Chandigarh, Dadra & Nagar Haveli, and Lakshadweep the ground water extraction for domestic & industrial uses is more than 40%. The overall stage of ground water development in the country is 63% (2020).

Global Scenario: In 2022, over 50% of global catchment areas experienced deviations from normal river discharge conditions. Most of these areas were drier than normal, while a smaller percentage of basins displayed above-normal or much-above-normal conditions. When compared to 2021, the scenario was somewhat similar, however, in 2021 a greater number of rivers experienced dry to normal conditions. Water inflow into a selection of major reservoirs in 2022 followed the trend in general discharge – more than 60% of reservoirs saw below-normal or above-normal inflow.

In South America, significant portions of Argentina, Paraguay, Uruguay, Chile and southern Brazil recorded below-normal to much-below-normal river discharge. In the La Plata river basin, drought conditions established since 2020 persisted into 2022 and resulted in impacts on agriculture, inland water navigation, energy production and water supply. Lower-than-normal precipitation totals continued to late September 2022, which exacerbated the already low river discharge.

In North America, the central and western regions of the United States showed below-normal to normal river discharge records; record low levels were observed in the Mississippi Basin in 2022, affecting barge movements along its waterway. The drought conditions in this area, which began in 2019, continued through 2022. In contrast, the Yukon (Alaska) and Mackenzie (Canada) river basins had much-above-normal and above-normal river discharge, respectively. Across the Winnipeg river basin the discharge was above average in 2022. More than half of the gauged tributaries across the basin set new all-time flow records and flooding lasted for months, causing extensive damage and states of emergency in the provinces of Ontario and Manitoba (Canada) and the state of Minnesota (United States).

The discharge conditions in the Horn of Africa were much below normal in 2022. The area continued to suffer the longest and the most severe drought event on record in 2022, which started in 2020, with much-below-normal annual discharge conditions. The extraordinary run of four successive dry rainfall seasons in the Horn of Africa, which may be partially attributed to human-driven warming, sea surface temperatures in the Indian Ocean and La Niña, was compounded by the arrival of a fifth rainy season in 2022 marked by scarce rainfall. The Congo River and the entire catchment of the Nile River in Central Africa exhibited reduced river discharge. In contrast, the Niger basin, and almost the entire territory of South Africa, including the Orange river basin, showed above-normal river discharge. The Niger basin and the east coast of South Africa (KwaZulu-Natal and Eastern Cape provinces) suffered major flood events in 2022.

Throughout Central and Western Europe, river discharge levels were below normal, as a result of extreme heat and drought in 2022. Basins draining the Alps and Carpathians into rivers such as the Danube, Loire, Rhine and Po, exhibited significantly low levels during the summer of 2022. Rivers in southern Norway and southern Sweden were also affected and exhibited below-normal discharge conditions. The entire territories of the Islamic Republic of Iran, Iraq, Syrian Arab Republic, Afghanistan and Myanmar, and the Amu Darya and Syr Darya basins in Central Asia saw below-normal and much-below-normal discharge conditions in 2022. Also, in the southern part of China, the Yangtze River, affected by drought and prolonged heat, reached record-low water levels53 affecting almost 5 million people.

India, and especially Pakistan, were hit by severe flooding in 2022 caused by very high precipitation concentrated during the monsoon period. The Godavari and Krishna Rivers in the southern part of India exhibited much-above-normal river 9 discharge in 2022. In Pakistan, the lower part of the Indus basin exhibited much-above-normal river discharge in 2022.

Eastern Australia, particularly the Murray–Darling river basin, exhibited above-normal river discharge conditions. In fact, several flood events occurred in Australia in 2022. Malaysia, Indonesia and the Philippines saw above-normal river discharge conditions, as well as the North Island of New Zealand. The river discharge conditions of the South Island of New Zealand remained near normal (***source: WMO-No. 1333 © World Meteorological Organization, 2023***).

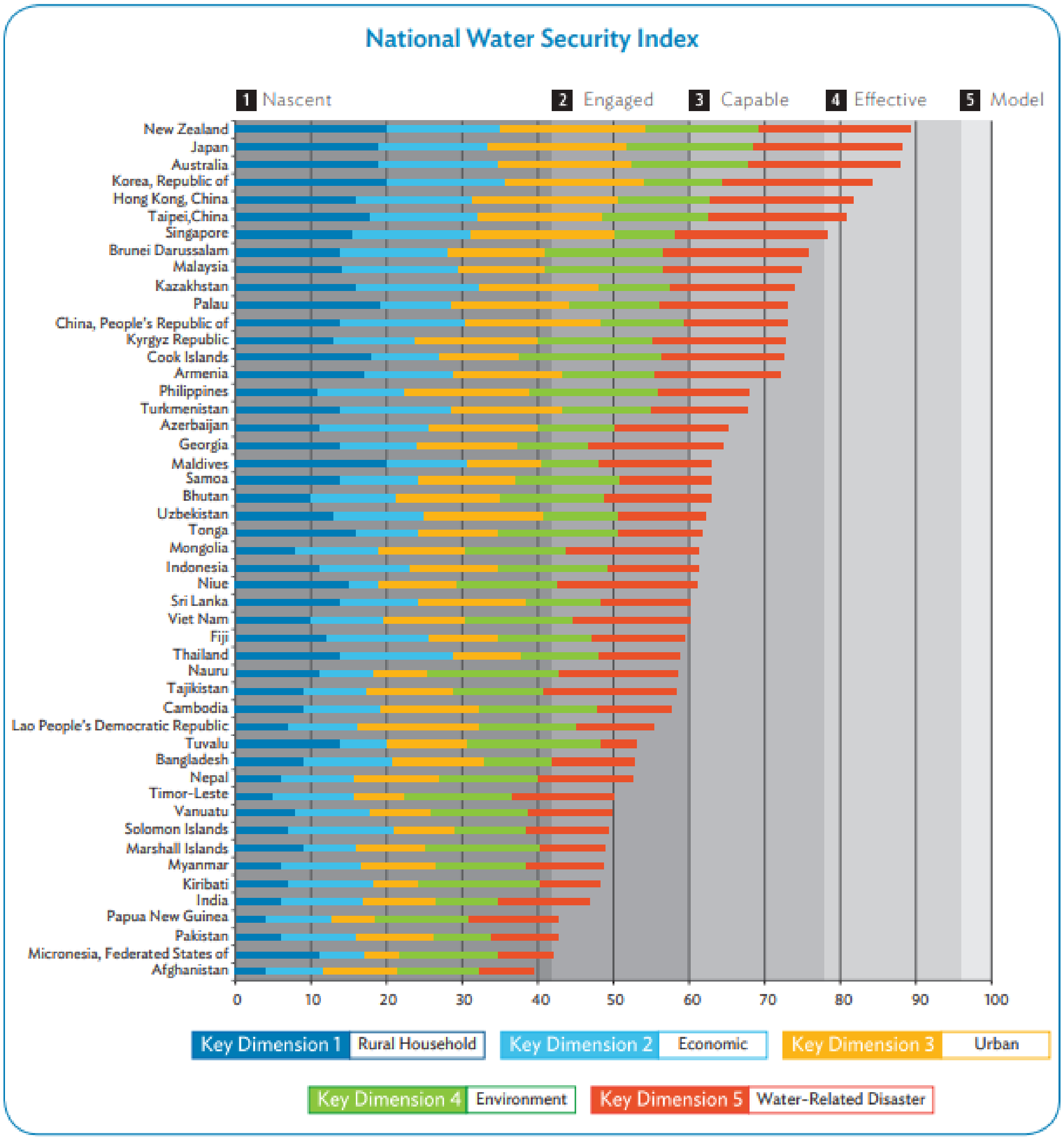
Similar Initiatives: The UWR RoU programme is unique, however, the concept is similar to the current approach involving the generation of Stormwater Retention Credits (SRCs) in Washington District, USA, which are given for projects that reduce harmful stormwater runoff by installing green infrastructure (GI) or by removing impervious surfaces. Installing new, voluntary GI in the Municipal Separate Storm Sewer System in Washington generates SRCs which provide the greatest water quality benefits to the District's water bodies. The price for such SRCs are controlled by the regulator and SRCs can be purchased on the open market. The system is designed on a cap and trade mechanism.

Methodology Key Elements

Typical Project Scopes	(i) measures which enhance the sustainable yield in areas where over-development has depleted the aquifer. (ii) measures for conservation and storage of excess surface water for future requirements and conservation of freshwater related ecosystems and wetland protection (iii) measures that improve the quality of existing ground water through dilution with rainwater runoff (iv) measures that remove bacteriological and other impurities from *seawater**, sewage waste water or contaminated water bodies, so that water is made suitable/fit for re-use and recycling purposes. (v) conservation measures taken to recycle and reuse water, spentwash, wastewater etc across or within specific industrial processes and systems.
Sustainability Goals	SDG 6, 11, 12, 13 No water quality requirements or restrictions are applicable at this time for the implementation of project activities which use this methodology. The project developer shall provide evidence that they are not engaged in profiteering from the project outcomes but rather any revenue is used to enhance access to conserving water and/or recharging water systems and/or clean, reliable drinking water and / or improving groundwater availability within the project's boundary of influence. Desalination systems must showcase brine management systems check on marine ecosystems and must be powered by renewable energy to use this methodology.
UNDP Human Development Indicator	All projects using this methodology must be ***ideally*** located in a country or region with a recent UNDP Human Development Indicator below 0.900 (source:

	http://hdr.undp.org/en/data) ***<u>However, countries and regions with higher HDI's will also be considered</u>*** taking the goal of UN SDG 17 into account, especially water conservation and recharge projects that encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships.
National Water Security Index, ADB	All projects using this methodology **<u>are ideally below</u>** the NWS score of 60 and NWSI equal or lower than 2 (NWSI ≤ 2). However, since the UWR RoU Standard must also respect every country's policy and leadership space that establishes and implements policies for sustainable water and groundwater development, ***<u>projects above the NWS score of 60 can also use</u>*** the methodologies outlined in the UWR RoU Standard and be eligible for RoUs under the programme. (source:https://www.adb.org/sites/default/files/publication/663931/awdo-2020.pdf)
Quantity	Annual RoU threshold is limited to **1,000,000 RoUs/year** (1 million RoUs/yr or 1000,000,000 litres/yr) over the entire crediting period **except in specific cases under Scope IV***. **Project activities (Scope IV or Scope 4) that involve voluntary measures to remove bacteriological and other impurities from, sewage waste water or contaminated water bodies, such that the water is made suitable/fit for re-use and recycling purposes can claim RoUs upto 2,000,000/year (2 million RoUs/year or 2000,000,000 litres/yr) over the entire crediting period.* .

**Desalination plants are eligible only if the plant is powered by renewable energy and clear documentation exists on brine management and no net harm to the local marine ecosystem.*


National Water Security Index
1 Nascent
2 Engaged
3 Capable
4 Effective
5 Model
New Zealand
Japan
Australia
Korea, Republic of
Hong Kong, China
Taipei,China
Singapore
Brunei Darussalam
Malaysia
Kazakhstan
Palau
China, People's Republic of
Kyrgyz Republic
Cook Islands
Armenia
Philippines
Turkmenistan
Azerbaijan
Georgia
Maldives
Samoa
Bhutan
Uzbekistan
Tonga
Mongolia
Indonesia
Niue
Sri Lanka
Viet Nam
Fiji
Thailand
Nauru
Tajikistan
Cambodia
Lao People's Democratic Republic
Tuvalu
Bangladesh
Nepal
Timor-Leste
Vanuatu
Solomon Islands
Marshall Islands
Myanmar
Kiribati
India
Papua New Guinea
Pakistan
Micronesia, Federated States of
Afghanistan
0
10
20
30
40
50
60
70
80
90
100
Key Dimension 1 Rural Household
Key Dimension 2 Economic
Key Dimension 3 Urban
Key Dimension 4 Environment
Key Dimension 5 Water-Related Disaster

National Water Security Stages

NWSI	NWS Score	NWS Stage	Description
5	96 and above	Model	All people have access to safe, affordable, and reliable drinking water and sanitation facilities. Economic activities are not constrained by water availability. Environmental governance is good, and pressure on aquatic ecosystems is limited. Water-related risks are acceptable and relatively easy to deal with.
4	78–96	Effective	Nearly all people have access to affordable safe drinking water and sanitation facilities. Economic water security is high. Environmental governance is generally acceptable, and attention is given to ecological restoration. There are systematic commitments to reduce disaster risk.
3	60–78	Capable	Access to safe drinking water and sanitation facilities is improving. Economic water security is moderate. Environmental governance is moderate, with clear pressure on the ecosystem. There are some institutional commitments to reduce disaster risk.
2	42–60	Engaged	A significant majority of rural and urban households have access to basic water supply but less to sanitation. Economic water security is low. Environmental governance is moderate, with severe pressures on aquatic ecosystems. Progress in achieving disaster risk security is low.
1	0–42	Nascent	A low proportion of rural and urban households have access to basic water supply and sanitation. Economic water security is low. Environmental governance is poor, with significant pressures on the aquatic ecosystems. Hardly any attention is given to disaster risk reduction.

NWS = national water security, NWSI = National Water Security Index.
Source: Asian Development Bank.

Metrics

All projects using this methodology will be required to maintain a ratio of $1m^3$ of unutilized water recharged/conserved/recycled to be eligible to generate 1 RoU

Rainwater offset credits = 1 RoU = 1000 litres of rainwater/unutilized water captured or recycled/reused/restored from systems (freshwater ecosystems included) and measures undertaken by individuals and entities per year.

Vintage year: Similar to the carbon vintage year concept, RoUs can be classified as the year in which the conservation, recharge or recycling of water took place and quantified or mined for the monitoring period **June 01, YYYY to September 30, YYYY or January 01, YYYY to December 31, YYYY** depending on the project activity (*e.g RWH systems could use the June-September monitoring period, while wastewater recycling or desalination systems would adopt the January -December monitoring period for RoU estimation*).

Earliest Vintage Start Date (UWR RoU Standard): January 01, 2014 onwards.

Commissioning Dates: Not applicable. Project activities can be commissioned anytime in the past. They must currently be operational or should have showcased operation or capture/reuse/recycle of unutilized water or rainwater in any of the preceding years (2014 at the earliest). Auditors and verifiers will audit the projects for operation/data parameters and installation dates as applicable during verification.

Data: Since the RoU is dependent on the flow rate and litres captured, this can either be done through installed flow meters or scientific quantification based on archived rainfall data available from government sources and appropriate run-off factors.

Reference: Users are encouraged to use the Indian Department of Water Resources Information System (https://indiawris.gov.in/wris) for water and rainfall data information.

As per the 2017 assessment of Dynamic Ground water resources, the total Annual Ground Water Recharge for the entire country (India) has been assessed as 432 billion cubic meter (bcm) and total natural discharges works out to be 39 bcm. Hence, the annual extractable Ground Water Resources for the entire country is 393 bcm.

RoUs can be banked indefinitely, meaning that buyers can purchase them and save them for use on future projects or for any compliance or ESG or NetZero credentials reporting purposes. Buyers of RoUs do not assume any liability for maintaining the RoU-generating project activity. RoUs are generated and issued ex-post.

Crediting Period: Not applicable. RoUs can be claimed for the "Lifetime of the Project Activity."

Quantity: All eligible project activities must limit their annual RoU threshold to **1,000,000 RoUs/year** (1 million RoUs/yr or 1000,000,000 litres/yr) over the entire crediting period (except activities as specified under the additional updated Scope IV or Scope 4 guidance below). If a project activity goes beyond the limit of 1 million RoUs/year, in any year of the crediting period, the water credits claimed by the project activity during this particular year will be capped at 1 million RoUs/yr for that year during the crediting period.

For the avoidance of doubt, no RoU/water credit project activity under this UWR protocol/standard can claim water credits over the threshold of 1 million RoUs in each year of the crediting period except in the following cases:

- *Project activities (Scope IV or Scope 4) that involve voluntary measures undertaken to remove bacteriological and other impurities from, sewage waste water or contaminated water bodies, such that the water is made suitable/fit for re-use and recycling purposes, can claim RoUs upto **2,000,000/year (2 million RoUs/year or 2000,000,000 litres/yr)** over the entire crediting period. The contaminated water body or sewage watsewater stream/s, **must be located outside the project boundary to claim such eligibility.***

Use Case Principle

The human appropriation of freshwater resources in terms of volumes of water consumed and polluted is termed as a water footprint (WF). Prior to the establishment of this Protocol/Methodology, it was acknowledged that the WF in one catchment could not be compensated for by offsetting activities to reduce the WF in another catchment. However, since the methodology being introduced here quantifies conservation, harvesting and recharging activities, it becomes the first methodology to award water offset units in terms of RoUs that can be used for offsetting purposes since it introduces an unutilized source of water, hence potentially compensating the WF of **virtual water** in supply chains, products and services worldwide. In the classic top-down approach, the WF of the people living in a province, nation or river basin is calculated as the total use of water resources in the area under consideration plus the gross virtual water import into the area minus the gross virtual water export. Virtual water import is the volume of water used in other countries to make goods and services imported to and consumed within the country considered. Virtual water export is the volume of water used domestically for making export products which are consumed elsewhere. Hence, the basis of any WF is the consumption aspect defined as the quantity of water consumed. The idea that a water offset for a WF should always occur in the catchment where the WF is located is not applicable and perhaps misplaced, since virtual water is already being imported and exported. Blockchain companies and commodity companies are already creating smart contracts, with a sort of "nutrition label" for every commodity that's been bought and sold to enable provenance. The supply chain industry for commodities is moving towards ESG tags for CO_2 emissions, female participation, data on whether it was involved in modern slavery and water pollution among other ESG parameters. The RoU when tokenized on blockchain can be attached/wrapped around such a blockchain system seamlessly showcasing water recycled, recharged and conserved. **The purpose of this standard is to encourage more entities and people to take on water conservation, recharging and recycling measures to protect the depletion of groundwater reserves worldwide. More importantly, this protocol serves to create a new incentive mechanism for such actions if used in conjunction with blockchain technology and for purposes other than WF purposes. It does not necessarily need to follow the centralized mechanism such as the "polluter pays compliance allowance system" or the "cap and trade" water entitlement market. Blockchain technology, decentralized finance and oracle pricing mechanisms can be designed to reward anyone willing to buy and sell the RoUs once tokenized or converted to smart fungible or non fungible tokens/contracts.** Environmentally conscious consumers from water-rich regions of the world can finally compare their WFs to their carbon footprint estimates for CO_2 emission or energy consumption.

Definitions

Aquifer Recharge: defined as the process of water being added to a groundwater system comprised of a geological structure or formation, or part thereof, permanently or intermittently permeated with water or capable of transmitting water'. Water introduced or recharged into an aquifer becomes 'groundwater.'

Aquifer A geological structure or formation, or part thereof, permeated with water or capable of being permeated permanently or intermittently with water and transmitting water. Geological unit containing groundwater. It must have sufficient porosity to hold water and sufficient permeability to allow easy flow. Porosity is created by the space between grains of rock, and by cracks and fissures. Aquifers occur on many scales, ranging from small and local units to 100s of square kilometers. Thickness ranges from one meter to 100s of meters. A water table (or unconfined) aquifer lies just below the ground surface, and is vulnerable to pollution. A confined aquifer lies below an impermeable rock layer (such as clay) which helps protect it from surface pollution.

Aquifer storage and recovery (ASR): The recharge of an aquifer via a well for subsequent recovery from the same well.

Aquifer storage transfer and recovery (ASTR): The recharge of an aquifer via a well for subsequent recovery from another well, to allow a minimum residence time in the aquifer before recovery.

Aquitard: A geological layer that has low permeability and confines or separates aquifers.

Borehole: A vertical below-ground installation to abstract groundwater. It is drilled (or bored) and lined with metal or plastic tubes to keep it open, and to protect against surface/near surface pollution. At depth, the tubes are slotted or filtered to allow water in but to prevent ingress of silt, sand or rock particles. In hard consolidated rock, the intake sections may be unlined. Borehole diameter is typically 10 to 30 cm, and depths range from a few meters to 100s of meters, with most less than 100 m. Colloquially, they are often called a well or water well (see water well). In South Asia, they are called tubewell. Water is usually abstracted with an electrical submersible pump installed some meters below the water level with a pipe connection to the surface.

Beneficial use: A use of the environment or any element or segment of the environment which (a) is conducive to public benefit, welfare, safety, health or aesthetic enjoyment and which requires protection from the effects of waste discharges, emissions or deposits or of the emission of noise or (b) is declared in India's environment protection policy to be a beneficial use.

Catchment: The geographical zone in which water is captured, flows through and eventually discharges at one or more points. The concept includes both surface water catchment and groundwater catchment. A surface water catchment is defined by the area of land from which all precipitation received flows through a sequence of streams and rivers towards a single river mouth, as a tributary to a larger river, or to the sea. A groundwater catchment is defined by geological structure of an aquifer and groundwater flow paths. It is replenished by water that infiltrates from the surface. It has vertical thickness (from a few metres to 100s of metres) as well as area. Depending on local conditions, surface and groundwater catchments may be physically separate or interconnected. "Catchment of origin" refers to a catchment, distinct from the site's catchment(s), where a product or service is manufactured or sourced. It may be anywhere from an adjacent catchment to the other side of the world. Alternative terms are watershed, basin and river basin.

'**Consumption**,' references in the WF industry **currently** refer to it as the as the loss of water from the available **ground–surface water body** in a catchment area, which happens when water evaporates, is incorporated into a product, or is transported to another catchment area or the sea. Consumption in case of this UWR Standard/Methodology refers to **sub-surface groundwater** resources being depleted and not recharged suitably to prevent future water disasters. Rainwater harvesting (RWH) and conservation, is a process of collecting, conveying, and storing the rainfall in an area for the beneficial purposes. Wastewater recyling and seawater desalination systems are also similar concepts mirroring RWH systems as an unutilized water source is being recycled or treated to replace freshwater or groundwater resources. The concept of virtual, or embedded, water was first developed as a way of understanding how water scarce countries could provide food, clothing and other water intensive goods to their inhabitants. The global trade in goods has allowed countries with limited water resources to rely on the water resources in other countries to meet the needs of their inhabitants. As food and other products are traded internationally, their water footprint follows them in the form of virtual water. For water-scarce countries it can sometimes be attractive to import virtual water (through import of water-intensive products), thus relieving the pressure on the domestic water resources. This happens, for example, in Mediterranean countries, the Middle East and Mexico. Northern European countries import a lot of water in virtual form (more than they export), but this is not driven by water scarcity. This potentially allows us to offset the WF of production/consumption, wherever they occur using RoUs. Hence, the consumption of water associated with a given product is usually not so much the water retained or held within the product itself but the water that was used to insure the production of this item (from agricultural irrigation for food, fibers or biofuels, process water for manufacturing or other indirect water consumption).

Contaminated water body: A water body that receives (or had received) untreated sewage, effluent discharge and/or industrial waste, and/or defined as 'heavily polluted' or "unfit for human consumption" by the authorities.

Disclosed Making a document available to relevant stakeholders and in some cases, publicly available or publicizing its availability, such as on the UWR

Discharge: Water-related discharge from a site, including drainage, wastewater (effluent), used cooling water and irrigation surplus. The quality of discharged waters may range from good to polluted, depending on it origin, its use, and treatments applied.

Effluent: Water or wastewater discharged from a site after being used. It is a more specific term than discharge (ie., not including drainage or runoff). The quality of effluent may range from good to polluted, depending on it origin, its use, and treatments applied.

Embedded/virtual water: Water that was used in the production or creation of an item, but not contained within it. For a crop, it is the water it needed to grow (irrigated or rain-fed), taken up by its roots and lost via transpiration, and is usually 100's of times more than the water physically retained within the crop. It may also include water used to wash, process and transport it. For a manufactured item (eg. a car, computer), it is the water used during its manufacture. For clothing, it includes the water to create the raw material (eg. cotton or wool) as well as that used in manufacturing. Alternative terms are ‘virtual water’ and ‘water footprint’. There are a range of methods and approaches to evaluating embedded water. Some include total water use, others only net water use. Some include the principal manufacture, others include the complete supply chain (eg. mining of raw materials).

Evaluated Having a documented and replicable process applied to monitor the implementation of the plan and related commitments and to make informed changes to the plan and its implementation. Implemented A process, procedure, or plan is carried out in order to achieve the intended result.

Freshwater: Freshwater plays a fundamental role in support of the environment, society and the economy. Ecosystems such as wetlands, rivers, aquifers and lakes are indispensable for life on Earth. Freshwater related ecosystems are also vital for directly ensuring a range of benefits and services such as drinking water and recreation, agriculture and energy, habitats for aquatic life forms and natural solutions for water purification and climate resilience. Freshwater related ecosystems can be defined as “a dynamic complex of plant, animal, and microorganism communities and the non-living environment dominated by the presence of flowing or still water, interacting as a functional unit.” (*Dickens and McCartney 2019; MEA 2005*). SDG target 6.6 aims for the protection and restoration of water-related ecosystems and includes indicator 6.6.1 which is framed around the monitoring of different types of freshwater related ecosystems including lakes, wetlands, groundwater and artificial water bodies such as reservoirs. In the indicator RoU methodology, reservoirs are also included as part of freshwater related ecosystems. Although reservoirs are not traditional ecosystems requiring protection and restoration, they contain significant freshwater in many countries and were therefore included in the UWR RoU Standard.

RoU projects capture and/or conserve and/or recycle/recharge unutilized rainwater/wastewater/seawater to persons/systems/processes and/or groundwater and/or artificial or natural subsurface storage systems which would not be possible without the project intervention by UWR members.

Rainwater is bacteriologically pure. free from organic matter and soft in nature.(source)

Rain Water Offset Unit or Credit (RoU) is a volumetric measure of water harvested or conserved through project activities on UWR and expressed as m^3 or 1000 litres of water per year. *It is not a measure of the severity of the local environmental impact of water harvested or consumed and is not based on water quality or pollution parameters.* Increasing, the supply of unutilized rainwater to groundwater and/or for reuse or recycling of process wastewater streams or treatment of unutilized seawater for potable purposes is the challenge this standard aims to address through the creation of RoUs.

RoUs are independent of point of use treatment systems, such as water filters (e.g. membrane, activated carbon, ceramic filters), solar energy powered ultraviolet (UV) disinfection, solar disinfection, photocatalytic disinfection, pasteurization, chemical disinfection (e.g. chlorination), combined treatment approaches (e.g. flocculation plus disinfection).

The availability of source water, one of the prime requisites for ground water recharge, is basically assessed in terms of non committed surplus monsoon run off, which as per present water resource development scenario is going or would have gone unutilised in the absence of the project activity.

Broadly speaking, the goal of assessing RoUs is to quantify efforts by human activities or specific products or projects involving capture of rainwater for groundwater recharge and/or conservation purposes related to recuse or recycling in a sustainable manner, including specific positive water project activities without any adverse impact to the environment or society.

Rainwater Harvesting Projects (e.g rooftop rainwater harvesting systems or a series of small check dams, can be submitted to the Universal Water Registry (UWR) as Programmes of Activities (PoAs). A PoA could be composed of several component projects (CPs). The PoA developer can decide when and how to divide the programme into CPs. The decision may be to start a new CP in a new geographic area, for example to reflect differing conditions between that area and other CPs, or alternatively the choice of starting a new CP may be in order to allocate a new start date to different beneficiaries from those included in an earlier activity. The decision could also be made to differentiate activity using one technology/measure from activity using another technology/measure. However, a single CP may include more than one technology/measure and different geographical areas if needed if the underlying baseline and quantification measures are relevant to all the areas and technologies/measures.

The total number of RoUs generated by a PoA is the sum of the RoUs generated by each CP for that vintage year. Once a specified group of project owners have been included in a CP, they cannot later be included in another CP.

Identified: Having some form of evidence (paper, electronic, or other) of conformance. Information presented shall be at a frequency, level of accuracy and over a sufficient time period to enable meaningful conclusions to be reached in relation to the indicator. This includes having a documented process(es) to identify and document the attributes listed.

Mapped: Maps should preferably be in a digital format and be of a quality that enables an external party to identify the location, scale and physical properties of the attributes listed. A physical diagram could be accepted when deemed better fit for purpose than a map.

Quantified: Numerical information presented shall be at a frequency, level of accuracy and over a sufficient time period to enable meaningful conclusions to be reached in relation to the indicator. This includes having a documented process to quantify (i.e., numerically) and document the attributes listed.

Groundwater: Water below the surface of the Earth stored in pore spaces and fractures within rock or layers of sand and gravel (aquifers). In water resources management the term more specifically applies to water that can be extracted at a viable rate, quantity and quality for human use (with or without treatment). Saline water or water contained in rocks of very low permeability is not conventionally considered groundwater.

Injection well A well that admits water into an aquifer, either by pumping or under gravity.

Native groundwater Groundwater that was present prior to recharge operations.

Reuse Utilisation of water for domestic, commercial, agricultural or industrial purposes, which would otherwise be discharged to wastewater or stormwater systems.

Best management practices – Water efficiency measures that save a quantifiable amount of water, either directly or indirectly, and that can be implemented within a specific time frame.

Data

Ground water levels are measured by the Central Ground Water Board, India four times a year during January, March/April/ May, August and November. The regime monitoring started in the year 1969 and currently has a network of 22730 observation wells, located all over the country. The premonsoon water level data is collected from all the monitoring stations during the months of March/ April/ May. For North eastern states premonsoon data is collected during March, since the onset of monsoon is normally observed in April. Similarly for Orissa, West Bengal and Kerala where monsoon appears early in May the monitoring is carried out during the month of April. For remaining states premonsoon monitoring month is May. Water levels during August are monitored to access the impact of monsoon on the ground water resources. Post monsoon data collected during November reflects the cumulative effect of ground water recharge and withdrawal of ground water for various purposes. January water level data indicates the effect of withdrawal for rabi crops.

India exported 3,850,431 litres of water between 2015-16 and 2020-21 (April-November). India exported three categories of water in this period: Mineral water (2,378,227 litres), aerated water (602,389 litres) and natural and other water (869,815 litres). Most of this water in 2019-20, went to China. Beijing imported 63,580 litres of mineral water, 1,000 litres of aerated water and 20,000 litres of natural water. It imported the highest quantity of mineral and natural water. Other major imports of Indian water were to the Maldives (38,380 litres), United Arab Emirates (35,510 litres), Canada (33,620 litres) Singapore (33,460 litres), United States (31,730 litres), Qatar (25,900 litres) and Saudi Arabia (29,020 litres) (source).

The availability of unutilized source water, one of the prime requisites for ground water recharge or conservation, is basically assessed in terms of non committed surplus monsoon run off, which as per present water resource development scenario is going unutilised. This component can be assessed by analyzing the monsoon rainfall pattern, its frequency, number of rainy days, maximum rainfall in a day and its variation in space and time. The variations in rainfall pattern in space and time, and its relevance in relation to the scope for artificial recharge to sub-surface reservoirs can be considered for assessing the surplus surface water availability.

“Hard” data (i.e., published and available to all stakeholders) should be used as much as possible; “soft” data (i.e., indirect evidence or the informed opinion of experts) should be avoided and only used as a last resort.

Applicability (Sectoral Scopes)

The UWR RoU Program deals with the following sectoral RoU scopes:

RoU Scope 1	Measures which enhance the sustainable yield in areas where over-development has depleted the aquifer.
RoU Scope 2	Measures for conservation and storage of unutilized water for future requirements including freshwater ecosystems and wetlands.
RoU Scope 3	Measures that improve the quality of existing ground water through dilution with rainwater runoff.
RoU Scope 4	Measures that remove bacteriological and other impurities from *seawater**, sewage and waste water, contaminated water bodies or unutilized water, so that water is made suitable for re-use and/or recycling.
RoU Scope 5	Conservation measures taken to recycle and/or reuse water, spentwash, wastewater etc across or within specific industrial processes and systems, including wastewater recycled/ reused in a different process, but within the same site or location of the project activity. Recycled wastewater used in off-site landscaping, gardening or tree plantations/forests activity are also eligible under this Scope.

**Desalination plants using seawater are eligible only if the project activity is powered by renewable energy and clear documentation exists on brine management and scientific data is provided that there is no net harm to the local marine ecosystem.*

UWR Reference Guide

UWR Project Developers/Proponents or Sellers **from India**, shall use a combination of the following available guides and manuals to develop, select default data values or factors in the PCNMR for their project activity:

(a) Rainwater Harvesting and Conservation Manual, 2019 (link) ,

(b) Guide on Artificial Recharge to Ground Water (link)

(c) Rainwater Harvesting Techniques To Augment Ground Water (link)

(d) Manual on Artificial Recharge of Groundwater (link)

(e) IS 15797: 2008 (link) and

(f) Water Data Guide (link)

(g) Ramsar Site Information for Wetlands (https://rsis.ramsar.org/ris-search/?f[0]=regionCountry_en_ss%3AIndia)

Projects outside India can use data available based on official publications or country specific data sets.

Approved Project Activities (Positive List)

- New private/non-state wetland/s, revival and/or restoration of degraded **state notified** wetlands as per **Ramsar Sites Annotated List** (Please refer to UWR Wetland Guidance Document)
- Freshwater ecosystems such as wetlands and **artificial water bodies such as reservoirs.**
- Percolation tanks with associated recharge shafts.
- Artificial recharge through lateral shafts with associated injection wells.
- Different types of artificial recharge structures such as sub-surface dykes, Nalla bunds, tank excavation and minor irrigation tanks that store the excess monsoon run off on the surface which other than supplying water for irrigation are also used to recharge the shallow unconfined aquifer to create additional subsurface storage for further utilisation.
- Sub surface barriers with associated gravity head inverted wells.
- Roof top / paved area rainwater runoff diversion into injection tubewell or well or tank.
- Replenishment of ground water reservoirs through artificial recharge by rainwater harvesting which involves inducing, collecting, storing and conserving local surface runoff.
- Gabion and check dam structures across streams. Construction of artificial recharge of stagnant water in depressions recharge shafts piercing through impermeable clay horizons.
- Taanka traditional rainwater harvesting technique.
- Panam keni type wells.
- Johad (small earthen check dam) system to conserve and recharge ground water.
- Kund system with associated underground well.
- Baoli harvesting system with associated drainage systems.
- Nadi pond system for rainwater harvesting.
- Zabo rainwater harvesting system, Jackwell bamboo interconnected rainwater harvesting systems, Traditional ramtek model of rainwater harvesting system.
- Eri (tank) system of rainwater harvesting.
- Desalination systems using seawater **are eligible only if they meet all** of the following:
    - *the project activity is powered by 100% renewable energy,* ***and***
    - *the brine generated by the desalination process or other types of waste, is not released into the surrounding environment causing damage to the marine ecosystem in the vicinity of the project activity.*
- All types of water purifications systems creating potable drinking water from previously untapped water resources.

Baseline methodology

Project boundary

The project boundary includes the physical, geographical site(s) of:

(a) The artificial recharge installation;

(b) Water conservation or management systems (including centralised purification plants where applicable);

(c) Systems that recover and/or recycle wastewater or unutilized water.

Baseline scenario

The baseline scenario for all RoU Scopes is the situation where, in the absence of the project activity must include one or more of the following:

- unutilized water flows uncollected into surrounding drains and/or
- unutilized water is not conserved/treated/recycled and/or
- unutilized water is not recharged and/or
- unutilized water is not harvested into a well/aquifer/sub-surface structure/above-ground storage tank/collection chamber, and/or
- water is extracted from multiple bore wells within the project boundary which would have depleted the local groundwater resources (aquifers) and/or
- water is diverted from existing safe drinking water resources from the surrounding areas
- Baseline scenario, if not directly measurable, is calculated by using one of the following two options:

Option 1:

Harvested water or Volume of water utilized (m^3) = Area of Catchment/Roof/Collection Zone (m^2) X Amount of rainfall (mm) X Runoff coefficient .

Option 2:

Harvested/Recycled unutilized water or Volume of sea water utilized (m^3) = Quantity of treated or recycled water in litres treated or harvested or volume of the artificial holding tank ($1m^3$ = 1000 litres).

Removals: Evapotranspiration for the vintage period should be taken into account for conservative estimates. Data can be obtained here https://indiawris.gov.in/wris/#/evapotranspiration or can be cross referenced with the UWR Water Data guide in the UWR document section.

Removals: Recharge Uncertainty as per Section 12.1 in the PCNMR and Evapotranspiration for the vintage period should be taken into account for conservative estimates. Water Data can be obtained here https://indiawris.gov.in/wris/#/evapotranspiration or Water Data (pdf) under the Documents Section on www.ucarbonregistry.io

APPENDIX

Project Concept Note & Monitoring Report

(PCNMR)

Project Name :_______________________

UWR RoU Scope:_____________________

Monitoring Period: DD/MM/YYYY-DD/MM/YYYY

Crediting Period: YYYY-YYYY

(Optional) UNDP Human Development Indicator:______

(Optional) National Water Security Index: _____

A.1 Location of Project Activity

State	
District	
Block Basin/Sub Basin/Watershed	Please refer to example for India- http://cgwb.gov.in/watershed/basinsindia.html
Lat. & Longitude	
Area Extent	
No. of Villages/Towns	

*Provide maps where applicable

A.2. Project owner information, key roles and responsibilites

It is important that the roles and responsibilities are clearly documented here within the management plan including clear lines of accountability and reporting Project owner shall attest to the following and that owner:

(a) owns the water user rights for the area within the project's boundary,

(b) holds an uncontested legal land title for the project area within the project's boundary,

(c) holds all necessary permits to implement the project or has applied for the same, AND

(d) provides cost details of project implementation .

A.2.1 Project RoU Scope

PROJECT NAME	
UWR Scope:	
Date PCNMR Prepared	

A.3. Land use and Drainage Pattern

- *(i)* Cultivable & Non-cultivable Area Forest
- *(ii)* Urban
- ***(iii)*** Other

Example:

DRAINAGEPATTERN:

Different types of drainage and stream order are very important for understanding the infiltration and runoff of the water. The Study area is falls in Sabarmati River basin. It is an inter- state river basin and is one of the 20 major river basins in India. It originates in the Aravalli hills of Rajasthan at an elevation of 762m above means elevate latitude24°40'Northand Longitude73°20'E'near the shrine of Ambe Bhavani. In the Rajasthan part, the basin extends over parts of Udaipur, Sirohi, Dungarpur, and Pali districts. In the Gujarat part, the basin extends over parts of six districts of Gujarat, namely, Sabarkantha, Banaskantha, Mehsana,Gandhinagar, Ahmedabad, and Kheda. The entire basin is divided into three sub basins, namely Dharoi, Hathmati, andWatrak.

Sabarmati River Basin is one of the most severely water-stressed river basins in India, with problems of water availability and quality, and experiences competition and conflicts over water use between and within different sectors of wateruse.

-DRAINAGEMAP

Source: India-WRIS (Govt. of India)

The problems pose a serious threat to sustainability of the water system, other ecological systems, and the socio-economic processes that are dependent on the basin'swater.These different types of drainage pattern mainly depend on the local geography, geology, structures and tectonics and also it depends on the slope of the area. The area is under the influence of Sabarmati River being the main recharging source & controlling the drainage pattern. The study area lies under the basin of Sabarmatiriver.Overall the drainage pattern of the area is dendritic.

A.4. Climate

(i) Type of Climate

- Humid
- Sub-Humid
- Arid

- Semi-arid

A.5. Rainfall

- (a) Average annual :______________mm
- (b) No. of Rainy days:________________
- (c) Temperature:___________

Example:

The project activity area experiences a hot to semi-arid climate. The summer season continues for about four months between March and June and the temperature rises as higher as 45^{0}C in the month of May and during winter it falls up to 10ºC during December. The Ahmedabad dist. as a whole faces acute shortage of water due to frequent failure of monsoon creating drought like situation.

The area is highly favorable for setting the monsoon in the fourth week of June and ends in the month of September. The overall annual average rainfall of the area is 750 to755mm. During this period, all the streams & channels are flopped with water. The short-term average rainfall of the Ahmedabad City is 754mm IMD (2000-2020) with about only 35 complete rainy days. The annual rainfall of the study area is tabulated in the Table no 1. During last 21 years period (2000-2020) maximum rainfall recorded was 1186 mm in the year 2010 & minimum was 382 mm in the year 2015.

The rainfall data also shows that during last 21 years only 10 years had received above normal annual rainfall and remaining period of the year received sub normal Rain. Rainfall plays an important role in the availability of groundwater inthis region and it is a major source for groundwater recharge.

TABLE NO. I *Annual Rainfall for last 21 years (2000 to 2020)*

Year wise Rainfall of Ahmedabad City (in mm)				
Year	Rainfall		Year	Rainfall
2000	559		2011	717
2001	638		2012	674
2002	397		2013	1153
2003	683		2014	901
2004	814		2015	382
2005	802		2016	574
2006	1044		2017	1022
2007	965		2018	418
2008	664		2019	851
2009	464		2020	932
2010	1186			0
AVERAGE RAI FALL IS—754MM				

A.6. Ground Water

(i) Description of aquifer: (*Refer Water Data Guide under Documents on www.ucarbonregistry.io or https://indiawris.gov.in/wris/#/Aquifer*)

(ii) Unconfined & confined aquifers

(a) Potable

(b) Brackish

(c) Saline

(ii) Any special quality problem, (Seawater intrusion, pollution, high fluoride etc.).

Additional Resource:

http://jalshakti-dowr.gov.in/sites/default/files/MasterPlanForArtificialRechargeToGroundWater2020.pdf

A.7. Alternate methods

Using base data on topography, rainfall, hydrogeology, aquifer situation land source water availability (if available), identify the methods which may be suitable and why the current method in the project activity was selected by the project proponent

A.8. Design Specifications

For individual structure at different locations, please describe the design specifications of the implemented project activity.Please include flow charts and diagrams where needed.

Please describe parameters involved in estimation of quantity that has been diverted for artificial recharge, the time for which the unutilized/source water was available, the quality of source water and the pretreatment required (if any) and describe the conveyance system being used to bring the water to the recharge site.

A.9. Implementation Benefits to Water Security

Describe the number of such types of artificial recharge structures needed to achieve or have been installed to meet the quantitative targets for the region or facility.

Example 1:

1. **Total plot area:** 48500 sq. mtrs.
2. **Constructed area:** 36000 sq. mtrs.
3. **Rooftop area:** 9000 sq. mtrs.
4. **No. of towers:** 7 with 27 floors each
5. **No. of apartments:** 1453
6. **Occupancy rate:** 90-95%
7. **Primary source of water:**
    a. Brihanmumbai Municipal Corporation line
    b. Sewage Treatment Plant
    c. Borewell
8. **No. of borewells:** 5 with depth of 250-300 ft. each
9. **No. of operational borewells:** 4
10. **Daily Water Requirement:**
    a. 1100 KL for domestic
    b. 500 KL for flushing

MAPPING OF THE EXISTING BOREWELLS:

Lowest point in the plot. It is still roughly 2 to 3 ft higher than road level. There is a big government nalla and storm water drain passing under property main gate.

Highest point in the plot. Roughly 20 to 25 ft higher than road level.

Example 2:

NEED FOR RECHARGE:-

The industrialization not only helps to strengthen the economy of the province but also affects the ecological and environmental balance of the area. In this situation the activity of artificial recharge to ground water is an important measure which is substantially beneficial, as this will help in storing the surplus rainwater in the form of ground water and in turn, arrest the decline of ground water level and degradation of its quality.

Natural replenishment of ground water reservoir is a slow process and is often unable to keep pace with the excessive and continued exploitation of groundwater resources in various parts of the country as well as in Gujarat State.

This has resulted in fast declining ground water levels and depletion of ground water resources. Artificial recharge efforts are basically aimed at augmentation of the natural movement of surface water into ground water reservoir through suitable civil construction techniques. Such techniques interrelate and integrate the source water to ground water reservoir and are dependent on the hydro- geological situation of the area concerned. Artificial recharge techniques aim at extending the recharge period in the post-monsoon season for about three or more months, resulting in enhanced sustainability of ground water sources during the lean season. The need and advantage of recharge is mentioned as under:

Need

- To overcome the inadequacy of waters to meet ourdemands.
- To arrest decline in ground waterlevels.

- To enhance availability of ground water at specific place and time and utilize rain water for sustainable development.
- To increase infiltration of rain water in the sub-soil; which has decreased drastically in urban areas due to paving of openarea.
- To improve ground water quality bydilution.
- To improve ecology of the area by increase in vegetation cover,etc.

Advantages

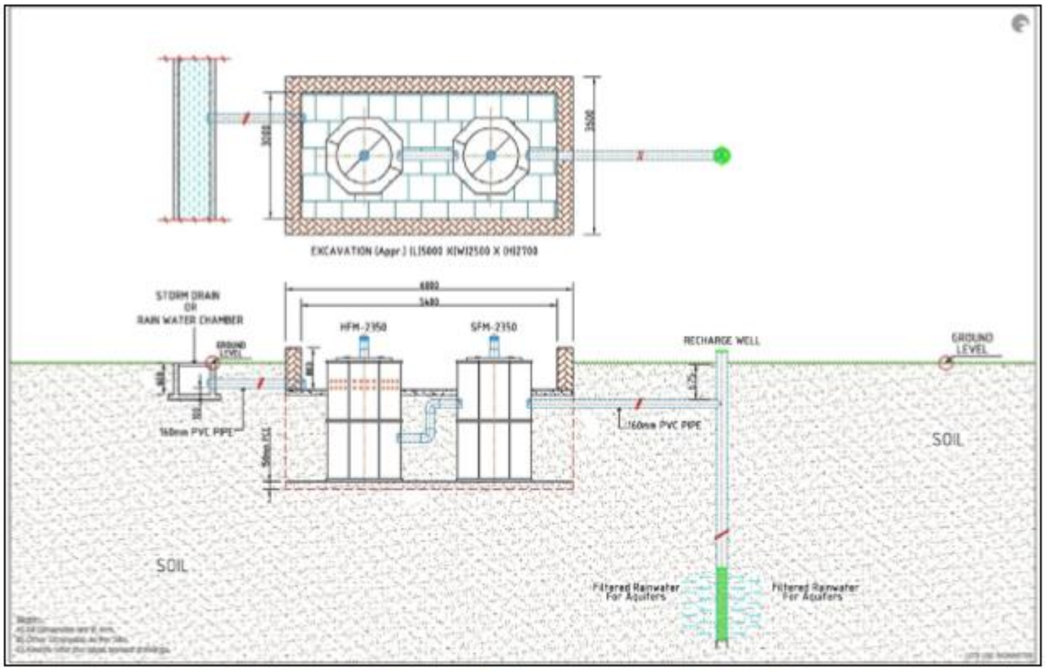
- ✓ Cost of recharge to sub-surface reservoir is lower than surfacereservoirs.
- ✓ The aquifer serves as distribution systemalso.
- ✓ No land is wasted for storage purpose and no population displacement isinvolved.
- ✓ Ground water is not directly exposed to evaporation andpollution.
- ✓ Storing water underground is environment friendly.
- ✓ It increases the productivity of aquifer and boosts rise in ground waterlevels
- ✓ It reduces flood hazards and soilerosion
- ✓ Mitigates the effects ofdrought.
- ✓ Theinjectionsoffreshfilteredrainwaterwillthewatertable&ultimatelythequantityof ground water in study area. This will reduce power consumption for itswithdrawal
- ✓ The fresh filtered rain water which will be diverted back to earth will be of around 100to 200 ppm TDS only, improves the ground water quality of the givenarea.
- ✓ Rainwater which is pure with virtually no dissolved salts and minerals flushes salt build up from the soil and produces lush-green and healthyplants.

METHODS AND TECHNIQUES OF RECHARGEINSTALLED

OPTION-I: SURFACEHARVESTING:

As per the rain harvesting plan, **xxx** has installed at . **xxxxxxx** ground water recharge in decentralized pattern. Rainwater is captured directly from surface through **xxx** units. Method and techniques of **xxx** installation in open trench:

SURFACE HARVESTING: - 1 NO HFM-2350 + 1 NO SFM-3475



A9.1 Objectives vs Outcomes

Describe in detail the objective of the project activity and the outcome post commencement of the activity. Provide diagrams and pictures where applicable for justification.

Example

Objective: *The major objective was to make the area water sufficient and poverty-free while increasing the water-harvesting capacity of the village. Ensuring participatory planning and educating women on watershed management.*

Outcome: *Farm ponds were made deeper than usual to conserve more rainwater and to ensure its availability for a longer duration. Changes in cropping pattern led to increased incomes. Higher yield and improved production of paddy. Emergence of fishery as a new livelihood activity, due to availability of sufficient water in farm ponds. Better yield in the lowlands due to water storage and seepage. Increased confidence of community members on farm ponds for irrigation. Vegetable farming using trellis proved profitable and many farmers now plan to grow more vegetables using water stored in the farm ponds.*

A9.2 Interventions by Project Owner / Proponent / Seller

Describe in detail the interventions carried out by the project activity to achieve the desired outcome.

Example

Awareness and capacity-building efforts were undertaken to identify the problem faced by the community and the willingness to resolve it. ƒ A hydrogeological mapping of the area was done to identify the recharge area of the critical springs more accurately. ƒ A water budget for the village was designed based on the estimated amount available for use and demanded by the community. ƒ For demand management, protocols were established in the village to ensure the sustained impact of the interventions. Some of the protocols included recharge area protection, social fencing, crop-water analysisbased farming, crop diversification, etc. *and the outcome post commencement of the activity.*

A.10. Feasibility Evaluation

Briefly evaluate the economic feasibility of the Project activity undertaken or prior third party findings and result and recommendations of audit reports as applicable.

A.11. Ecological Aspects :

Please provide a description of the potential environmental/ecological Problems being addressed by the project activity in terms of

- *a) Inundation of habituated land*
- *b) Creation of water logging and vector disease prevention mitigation*
- *c) Deterioration of quality of groundwater*

A.12. Recharge Aspects :

Please document efforts taken to ensure that the *Quality of Surplus Recharge water is clean, free from contamination and has compatibility with quality of native ground water in aquifers.*

A.12.1 Solving for Recharge

Ultimately, the volume of groundwater recharge benefit to the subbasin is the most critical aspect for such MAR activities. Groundwater recharge is quantified as the deep percolation of surface water applied during project implementation. Using a field-scale water budget, deep percolation can be calculated as the difference between all other inflows and outflows, per the equation below, with each other inflow and outflow being quantified:

Recharge = Rainfall + Surface Inflow – Evapotranspiration – Surface Outflow – Change in Storage

Evapotranspiration & Other Data: https://datameet-pune.github.io/open-water-data/docs/open-water-data-paper.pdf (or available under Documents Section- Water Data Guide)

Root Zone = The root zone is comprised of the upper portion of the soil where water extraction by roots occurs, above the depth at which water infiltrates to the groundwater system. The depth to the bottom of the root zone varies by crop, but typically extends up to seven feet.

Surface Inflow= Surface inflows can be either directly measured or calculated from measured values. In fields directly served by metered lift pumps or metered gates, the volume of surface inflows to the field can be directly measured or calculated from totalized measurements. Typical accuracies of pipe flow measurements range from 1-12 percent. In fields that are indirectly supplied with surface water, surface inflows may need to be calculated from upstream and downstream flow measurements, or through theoretical or empirical equations relating available data to field surface inflows. For example, fields served from canals measured using weirs, or fields served from canals that deliver water to multiple locations downstream of a measurement device may require site-specific calculations to quantify surface inflows to a specific field. Low-cost in-field measurements can also be made by setting up flashboards at the measurement location and correlating the “runup” of an unsubmerged weir overflow on a flat weir stick to the flow rate using standardized equations. Typical accuracies of “runup” or indirect flow measurements may exceed 10 percent, depending on site conditions and the accuracy of measurement data.

To monitor surface inflows, project owners may record flow data, maintain irrigation logs, and maintain logs of any other parameters required to calculate field deliveries, depending on the unique conditions of their field. Project owners may also consider using mobile flow monitoring equipment to measure or verify surface inflows .

Surface Outflows: To monitor surface outflows, users may record flow data or water level data and maintain logs of any other parameters required to calculate outflows, depending on the unique conditions of their project activity. Pressure transducers and dataloggers may be used to automatically monitor water levels, or users may install wooden stakes to manually monitor water depths.

Change in Storage = The change in surface storage, or average ponded water depth, can be calculated from measured and observed changes in water surface levels at points throughout the project field. Over the annual project implementation period, **the total change in surface storage is typically zero**, provided that the surface of a field is dry and free of ponded water at the start and end of the project.

While the uncertainty of each inflow and outflow will vary based on field conditions and measurement devices, typical uncertainties associated with each water budget component are summarized in the table below. The uncertainty of deep percolation (i.e., recharge) can then be calculated from these other uncertainties, for example following the process described by Clemmens and Burt (1997). Users can use the following table to eliminate uncertainty from their estimates.

Water Budget Component	Typical Estimated Uncertainty (%)	Description
Surface Inflow	1-12%	Typical range of accuracy from meters to minimum delivery accuracy requirements of delivery and diversion measurement devices.
Precipitation	2-20%	Typical range of accuracy from field-level rain gauges to extrapolation of local weather station data
Surface Outflow	1-20%	Typical range of accuracy from meters to estimated outflow relationships

Evapotranspiration	20.00%	Clemmens and Burt, 1997; typical accuracy based on free water surface evaporation coefficient.
Change in Storage	15-25%	Estimated accuracy of change in storage calculation based on fieldscale water budget calibration to observed water levels.
Deep Percolation	5-30%	Typical range of calculated accuracy from field-scale water budget results (fields ranging from 56 to 125 acres)

Other factors of uncertainty to consider when quantifying recharge are:

- Deep percolation does not immediately recharge the groundwater system. There is a time lag between when deep percolation occurs through the root zone and when that water reaches the saturated groundwater system.
- Subsurface inflows and outflows can occur through the groundwater system. While deep percolation may supply water to the groundwater system, that water may migrate away from the field along groundwater gradients.

Groundwater recharge can also be monitored and verified through groundwater level measurements at groundwater wells adjacent or near to the project activity. For instance, groundwater level measurements collected before, during, and after implementation can potentially help verify that net recharge is occurring; especially in well-positioned wells with continuous monitoring.

A.13. Quantification Tools

The following tools are recommended to be used to estimate the quantity of RoUs in the absence of tamperproof flow meters or systems that accurately quantify the volume in litres or m3 of water being harvested or conserved by the project activity.

Water Harvesting Potential

Water harvesting potential of any catchment area is to be calculated under this methodology for each given year that the RoU is being claimed. The total amount of water that is received from rainfall over an area is called the rainwater legacy of that area. The amount that can be effectively harvested is called the water harvesting potential.

The formula for calculation for harvesting potential or volume of water received or runoff produced or harvesting capacity is given as:-

Harvesting potential or Volume of water utilized (m3) = Area of Catchment/Roof/Collection Zone (m2) X Amount of rainfall (mm) X Runoff coefficient .

Runoff coefficient

Runoff coefficient for any catchment is the ratio of the volume of water that runs off a surface to the volume of rainfall that falls on the surface. Runoff coefficient accounts for losses due to spillage, leakage, infiltration, catchment surface wetting and evaporation, which will all contribute to reducing the amount of runoff. Runoff coefficient varies from 0.5 to 1.0. Rooftop rain water harvesting systems shall use the runoff coefficient equal to 1 as the rooftop area is totally impervious. Eco-climatic conditions (i.e. Rainfall quantity & Rainfall pattern) and the catchment characteristics are considered to be most important factors affecting rainwater harvesting potential .

Type of Area	Recommended Runoff Coefficient (K)
Residential	0.3 to 0.5
Forest	0.5 to 0.2
Commercial & Industrial	0.9
Parks and Farms	0.05- 0.3
Asphalt or Concrete Paving	0.85
Road surface	0.8-0.9

Runoff Coefficient of Different Surfaces

Different Surfaces	Runoff Coefficient (K)
Roof conventional (Flat)	0.7 to 0.8
Roof inclined (Sloping)	0.85 to 0.95

Concrete/Kota Paving	0.6 to 0.7
Gravel	0.5 to 0.7
Brick Paving	0.7

Annual Rainwater harvesting Potential

Annual rainwater harvesting potential is given by V = K × I× A

Where, V=Volume of water that can be harvested annually in m^3 .

K = Runoff coefficient

I = Annual rainfall in (m)

A = Catchment area in (m^2)

Rainfall intensity in the catchment area

The rainfall intensity of the area is to be found out from the local IDF -curves (intensity-durationfrequency curve), if IDF-curve is not available, rainfall intensity default of 100 mm/hr shall be considered (this value is for tropical countries, with catchment areas smaller than 150 ha).

Analysis of the catchment area

The gradient of the catchment area, terrain configuration in the catchment area can be found out from the State Maps and the Runoff factors for the different terrain are given as below. Coefficient of Runoff Values for Different Terrains

Terrain type	'C' Coefficient of Runoff (Flat terrain)
Clayey soil	0.8 2
Parking area	0.75
Roads and other concrete works	0.85
Green belts	0.1

Rainfall infiltration method

In areas where ground water level monitoring is not adequate in space and time, rainfall infiltration may be adopted. The norms for rainfall infiltration contributing to ground water recharge are evolved, based on the studies undertaken in various water balance projects in India. The norms for recharge from rainfall under various hydrogeological situations are recommended in the following table

Table : Rainfall infiltration factor in different hydrogeological situations

S.No	Hydrogeological situation	Rainfall infiltration factor
1	Alluvial areas	
	a. Sandy Areas	20 to 25 percent of normal rainfall
	b. Areas with higher clay content	10 to 20 percent of normal rainfall
2	Semi-Consolidated Sandstones (Friable and highly porous)	10 to 15 percent of normal rainfall
3	Hard rock area	
	a. Granitic Terrain	
	(i) Weathered and Fractured	10 to 15 percent of normal rainfall
	(ii) Un-Weathered	5 to 10 percent of normal rainfall
	b. Basaltic Terrain	
	(I) Vesicular and Jointed Basalt	10 to 15 percent of normal rainfall
	(ii) Weathered Basalt	4 to 10 percent of normal rainfall
	c. Phyllites, Limestones, Sandstones, Quartzites, Shales, etc.	3 to 10 percent of normal rainfall

Additional Guidance On Groundwater Recharge estimates and guidelines:

UWR recommends following the estimates and guidelines outlined here http://cgwb.gov.in/documents/Manual%20on%20Artificial%20Recharge%20of%20Ground%20Water.pdf

Interim Report on Project wise Impact Assessment of Completed Demonstative Artificial Recharge Projects of XI Plan (http://cgwb.gov.in/Ar-reports.html)

Additional Guidance For Rooftop Rainwater Harvesting Systems:

In order to be conservative in the estimation of the quantity of rainwater harvested, RWH users of this methodology are advised to also refer to **IS 15797:2008 Indian Standard Roof Top Rain Water Harvesting** guidelines on estimation.

Table 1 can also be used for conservative estimates for Rooftop Rainwater Harvesting Systems:

Table 1 Availability of Rain Water through Roof Top Rain Water Harvesting

Rainfall(mm)	100	200	300	400	500	600	800	1000	1200	1400	1600	1800	2000
Roof top area (sqm)	Harvested water from Roof top (cum)												
20	1.6	3.2	4.8	6.4	8	9.6	12.8	16	19.2	22.4	25.6	28.8	32
30	2.4	4.8	7.2	9.6	12	14.4	19.2	24	28.8	33.6	38.4	43.2	48
40	3.2	6.4	9.6	12.8	16	19.2	25.6	32	38.4	44.8	51.2	57.6	64
50	4	8	12	16	20	24	32	40	48	56	64	72	80
60	4.8	9.6	14.4	19.2	24	28.8	38.4	48	57.6	67.2	76.8	86.4	96
70	5.6	11.2	16.8	22.4	28	33.6	44.8	56	67.2	78.4	89.6	100.8	112
80	6.4	12.8	19.2	25.6	32	38.4	51.2	64	76.8	89.6	102.4	115.2	128
90	7.2	14.4	21.6	28.8	36	43.2	57.6	72	86.4	100.8	115.2	129.6	144
100	8	16	24	32	40	48	64	80	96	112	128	144	160
150	12	24	36	48	60	72	96	120	144	168	192	216	240
200	16	32	48	64	80	96	128	160	192	224	256	288	320
250	20	40	60	80	100	120	160	200	240	280	320	360	400
300	24	48	72	96	120	144	192	240	288	336	384	432	480
400	32	64	96	128	160	192	256	320	384	448	512	576	640
500	40	80	120	160	200	240	320	400	480	560	640	720	800
1000	80	160	240	320	400	480	640	800	960	1120	1280	1440	1600
2000	160	320	480	640	800	960	1280	1600	1920	2240	2560	2880	3200
3000	240	480	720	960	1200	1440	1920	2400	2880	3360	3840	4320	4800

Source: CENTRAL GROUND WATER BOARD MINISTRY OF WATER RESOURCES GUIDE ON ARTIFICIAL RECHARGE TO GROUNDWATER 2000

Quantification

Year (January 01, 2014 onwards)	RoUs (1 RoU = 1000 litres)/yr *
DD/MM/YYYY	Number

Conservative Approach: The UWR RoU Verifier is recommended to apply a 10-50% uncertaintity factor related to degree of uncertainity to the final quantity of RoUs calculated for vintage years 2014-2021. However, a more conservative approach to uncertaintity may be selected by the RoU Verifier as per its discretion.	

******All calculations of RoUs for* ***rooftop rainwater harvesting systems*** *should be rounded down against the lower of the two values (if any) between RoUs calculated and RoU values as per IS 15797:2008 for the given area of rooftop and rainfall received in the year (2014 onwards).*

Example:

RAINWATER HARVESTING POTENTIAL:

Possible Rainwater Calculation of Water Volume @ Different Co-efficient at following Intensities/day: -

IMD data over the past 13 years shows the highest seasonal rainfall, prior to 2019, was recorded in 2010 — 3,327.9 mm over four months (June to September). The annual average rainfall for Mumbai is 2,514mm, while the seasonal average is 2,317mm.

Possible Rainwater Collection for The Total Plot Area @ 25mm Peak

Sr. No.	Area in Sq. mtrs.	Possible water collection per year @ 2514mm	Possible water collection @ 25mm peak	Co-efficient
1.	48500	60964 M^3	606 M^3	50%

Possible Rainwater Collection for The Total Plot Area @ 50mm Peak

Sr. No.	Area in Sq. mtr.	Possible water collection per year @ 2514mm	Possible water collection @ 50mm peak	Co-efficient
1.	48500	60964 M^3	1212 M^3	50%

Possible Rainwater Collection for The Total Plot Area @ 75mm Peak

Sr. No.	Area in Sq. mtrs.	Possible water collection per year @ 2514mm	Possible water collection @ 75mm peak	Co-efficient
1.	48500	60964 M^3	1819 M^3	50%

Possible Rainwater Collection for The Total Plot Area @ 100mm Peak

Sr. No.	Area in Sq. mtrs.	Possible water collection per year @ 2514mm	Possible water collection @ 100mm peak	Co-efficient
1.	48500	60964 M^3	2425 M^3	50%

A.14. UWR Rainwater Offset Do No Net Harm Principles

Describe how the project activity accomplishes the following:

- Increase the sustainable water yield in areas where over development has depleted the aquifer
- Collect unutilized water or rainwater from going into storm drains or sewers
- Conserve and store excess water for future use
- Enhance local women's participation and professional development

A.15. Scaling Projects-Lessons Learned-Restarting Projects

Please describe how the project can be scaled further and take into account existing integrated practices, as well as areas of duplication that might contribute to better water and urban management.

Example:

Efforts to introduce wastewater recycling for direct potable water supply have failed in many cities because of the perception that reclaiming drinking water from municipal effluent is generally unacceptable to the public. However, the experience in XYZ showed that with persistent, well-designed, and targeted communication to the public, this perception can be changed. The people of the village XYZ generally take pride in the fact that they are one of only a few villages in the world where direct potable water reuse is practiced. Furthermore, there is evidence to show that this is indeed a safe practice: in 5 years of recycling water for drinking water supply, the village has not had a single outbreak of waterborne disease linked to this practice.

Example:

Stormwater harvesting for domestic use had to be abandoned at some sites as it turned out not to be the most cost-efficient option when the full range of costs and benefits were taken into account. However, the revenue from the sale of RoUs under the UWR Program has now meant that such stormwater harvesting abandoned earlier can be restarted.

It's proposed that in 2023, the PP will undertake 32 abandoned stormwater projects and the water will be supplied to gardens and sports clubs, totaling 1.4 million m3 of water supply.