TERMS OF REFERENCE

1. **Title of the Project**: 'Developing the standard procedure for evaluation and assessment of microplastics in water'.

2. Background:

The project titled 'Developing the standard procedure for evaluation and assessment of microplastics in water' has emerged from the need of a new standard which delves in micro plastics characterisation and a standard procedure which defines the analysis of microplastics . Since microplastic pollution is becoming an ever increasing menace for surface as well as ground water , it is extremely important to define the standard method for sampling , extraction and analysis of microplastics in water . The only related BIS document available in this field is of IS 17899 T : 2022 ASSESSMENT OF BIODEGRADABILITY OF PLASTICS IN VARIED CONDITIONS . However, it does not provide any details on the classification, sampling strategies, extraction or analytical methodology to be employed for micro plastics estimation in water . Hence, there is an urgent need to develop a **New Standard** that clearly defines each of the aforementioned activities in terms of micro plastic polymers.

Microplastics are small plastic polymers exhibiting a size less than five millimeters long and are extremely harmful to the environment and aquatic life. Their identified sources vary from larger plastic debris that degrades into smaller pieces, microbeads that are used in health and beauty product and resin pellets used for plastic manufacturing. These dangerous entities can enter drinking water sources from a number of ways, including surface run-off, wastewater effluent, industrial effluent, and atmospheric deposition. Microplastics and nanoplastics have been detected in practically all the water sources including marine water, wastewater, fresh water, and drinking water, which not only make it unsuitable for consumption but also causes many diseases.. In order to understand the effects of micro plastics, it is important to standardise a protocol to detect these polymers in water and further characterise them.

Indian freshwater ecosystems have micro plastics originating from polyethylene and polystyrene, which again are derived from plastic paints, boats, and synthetic products. Additionally, polypropylene (PP), poly(ethylene terephthalate) (PET), and polyethylene (PE) have also been found to be the most common polymer types,

accounting for 74% of the microplastics in Indian freshwater ecosystems . These findings thus highlight the prevalence of specific types of microplastics finding their way in Indian freshwater ecosystems, emphasizing the need for targeted research and mitigation strategies to address this form of pollution.

3. Scope: The project ' Developing the standard procedure for evaluation and assessment of microplastics in water' aims to detect, analyse and characterise various microplastic polymers found in water. The primary objective of the study is the sustainable supply of clean and safe water. The scope involves following core areas:

1. Detection of micro plastics.
2. Sampling of micro plastics along with defining Sample extraction methodology
3. Identification and characterisation of micro plastic polymers.
4. Quantification of micro plastics
5. Development of permissible limits for micro plastics in drinking water.

This standard shall fall under the purview of the field 'Environment Impact assessment' with the specific subject area 'Conservation of aquatic ecosystems in reservoirs and lakes' defined in Standards National Action Plan (SNAP) 2022 -27

4. Expected Deliverables:

Though World Health Organisation has come up with a standard on micro plastics in Drinking water in the year 2019, no such standard is available in India. Thus , this standard shall pave way for formulating a defined methodology for estimating microplastics in water . Simultaneously it will ensure

1. **Safe water availability**: Detection of micro and nanoplastics in water will help in understanding their prevailing concentration in water, ensuring that the drinking water is suitable for human consumption .
2. **Development of standards:** As mentioned earlier, there are no specific standards available for microplastics in ground or surface water. Though many agencies in India like CPCB , ICMR , CIPET (Central Institute of Petrochemicals Engineering & Technology) are individually conducting studies on microplastics , no specific protocols for either identification or characterisation of microplastics are available . Details regarding the sampling , identification and characterisation shall help in formulating guidelines for their release in water bodies.

3. **Policy formulation :** Policies to reduce microplastics pollution in water could further be drafted . This shall ensure that standards of minimum generation of microplastics are abided by for various product manufacturing
4. **Reduced health risk:** After their identification and quantification, assessment of micro plastics in water shall be carried out in various water sources and regions leading to inference regarding the gravity of the current situation. This evaluation shall be paramount in determining the effort required for ensuring clean water supply for all.
5. **Sustainable development Goal :** The outcome of this project shall align with UN SDG Goal 6 of Clean water and Sanitation . The project outcome will advance the cause of proper management of water resources

5. Research Methodology:

1. Detailed Literature Review:

- A detailed review of literature would have to be carried out in order to understand the growing microplastic trends in the past decade. Besides micro plastics release, synthesis of derivatives like Biofilms that result from attachment of microorganisms to the plastic surface leading to a complex extracellular matrix shall also have to be researched upon. Thus literature review, not only, in terms of micro plastics alone but secondary pollutants derived from microplastics shall also have to be studied in depth.

2. Collection of water samples:

- Collection of groundwater samples for the detection of micro plastics: Various techniques like plankton nets and sieving that can be used for the collection of micro plastics shall be identified along with standardizing the protocol for collection of microplastic samples .

3. Analysis and Characterisation:

- The next step shall be standardization of methodology to examine microplastics in water using sedimentation and visual imaging methods. In addition to FTIR, Raman spectroscopy, and microplastic-specific immunoassays, advanced analytical techniques such as FTIR and Raman spectroscopy are generally employed to analyze and characterize microplastics. These techniques will be standardised to give the qualitative and quantitative estimation of all these plastic polymers.

4. **Field surveys:**
    - Various field surveys will be conducted in order to assess and evaluate the prevailing scenario and sources of micro plastics in the study area.
    - Awareness campaigns to spread a word about emerging micro pollutants could also be planned simultaneously.
5. **Seasonal assessment of samples:**
    - Collection of samples will be done during 2 to3 seasons (say pre-monsoon and post-monsoon) depending on the tenure of the project.
    - Samples will be analysed to study the relationship between various environmental factors and microplastics.
6. **Data interpretation:**
    - The data analysis shall be done using statistical techniques , and the severity of microplastic contamination in water sources will be determined based on the microplastics' concentration, types, and effects.
    - Obtained data will be used to analyse and evaluate the potentially polluted sites along with identification of various sources of micro plastics release.
7. **Suggestive standards for Continuous Monitoring:**
    - Development of standards in order to control micro plastic contamination will be suggested so that the continuous monitoring of micro plastics can take place.

6. Requirement for the CVs:

For the successful completion of the project 'Developing the standard procedure for evaluation and assessment of micro plastics in water', the following key requirements of CVs of persons to be engaged:

1. Educational Background:
    - A minimum of a Master's degree in Sciences in a relevant field
    - Doctorate degrees in related field (like Applied Chemistry , Environmental Engineering etc.).
2. Professional Experience:
    - Demonstrated experience in research and development projects related to micropollutants in water.
    - Familiarity with working on emerging microcontaminants including microplastics.

3. Technical Skills:
    - Hands-on experience with laboratory testing equipment and protocols for microplastic assessment.
    - Proficiency in relevant statistical software for data analysis and modelling.
4. Research Publications and Contributions:
    - A track record of research publications in areas relevant to emerging micro contaminants including microplastics .
5. Project Management and Collaboration:
    - Demonstrated ability to effectively manage projects, including budgeting, timeline adherence, and coordination with stakeholders.
    - Strong interpersonal and communication skills to facilitate collaboration with team members, stakeholders, and experts.
    - Skills to talk in the local language with the local population.
6. Innovation and Problem-Solving Skills:
    - Evidence of innovative thinking and problem-solving skills, particularly in the context of microplastic sampling techniques.
7. Previous Project Experience:
    - Details of previous projects worked on, with a focus on those related to microplastics, their evaluation, tentative removal strategies & health risk assessment related to water resources.
8. Certifications and Training:
    - Any relevant certifications, training, or workshops attended in areas related to microplastics and health risk assessment related to water .
9. Availability and Commitment:
    - Availability for the duration of the project and a commitment to meeting project milestones and deadlines.
10. Language Proficiency:
    - Proficiency in English for effective communication and documentation related to the project.

7. Timeline and Method of Progress Review:

1. Stage 1: Project Initiation and Planning
    - Duration: [15 days]
    - Tasks:
        - Conduction of initial literature review to obtain available data on microplastic pollution in the areas.

        - Developing a detailed project plan, including milestones, deliverables, and resource allocation.
    - Progress Review: Weekly team meetings to track progress against the project plan.
2. Stage 2: Finalising the study area and sampling
    - Duration: [15 days]
    - Tasks:
        - Reconnaissance surveys in the study area.
        - Collection of water samples form the study area.
    - Progress Review: Mid-term review meeting to assess design progress and material selection.
3. Stage 3: Laboratory Testing
    - Duration: [1 month]
    - Tasks:
        - Sample preparation for the analysis of microplastics.
        - Removal of organic and inorganic matter from the water samples collected.
    - Progress Review: Bi-weekly progress reports on testing and obtained results.
4. Stage 4: Development of detailed list of microplastic polymers
    - Duration: [1month]
    - Tasks:
        - Based on results obtained from testing , a list of polymers obtained from different sampling locations will be made.
        - The sources of pollution will be identified and compared.
    - Progress Review: Monthly reports will be made to understand the sources of pollution.
5. Stage 5: Data Analysis and Interpretation
    - Duration: [1 month]
    - Tasks:
        - Quantification of microplastics through analysis of obtained data from laboratory tests.
        - Interpret findings to suggest suitable techniques for assessment of microplastics.
    - Progress Review: Interim report on data analysis and interpretation.

6. Stage 6: Report Compilation and Documentation
    - Duration: [1 month]
    - Tasks:
        - Compilation of final project report, including results of qualitative and quantitative testing and characterization
    - Progress Review: Review of the final draft report.
7. Stage 7: Development of Standards for micro plastics in water and Project Closure
    - Duration: [1 month]
    - Tasks:
        - Winding up of the administrative tasks, finalization of project documentation, and development of a standard for evaluation and assessment of micro plastics in water.
    - Progress Review: Final project review meeting to assess overall project outcomes and way ahead.

8. Support BIS will Provide:

The following are the specific areas in which BIS shall extend assistance:

- Technical Guidelines and Publications related to project
- Expert Guidance and Consultation for generation of baseline data on microplastics
- Access to Testing Laboratories for analysis of microplastics
- Bringing in domain knowledge experts in the field of microplastics .
- Technical Workshops and Seminars on microplastics
- Conductance of Surveys for understanding health risk caused by microplastics
- Access to Research Journals and Databases
- Information on Best Practices to prevent the microplastic pollution
- Documentation Review and Feedback
- Development of Microplastic Standards