IIT Bombay invites digitally signed Technical Bid & Financial Bid for following work from the contractors having similar experience in Central Government Departments / State Government Departments / Central or State Autonomous Bodies / State or Central Public Sector Undertakings & Large Private Organizations. The detail of work is given below:

Sr. No.	Name of Work	Estimated Cost (In Rs.) Incl. 18% GST	EMD (Rs.)	RFX (Online mode)	Duration of contract
1	Green Space Audit in the IIT Bombay Campus. **EO/A/HORT/WKS-129/25-26**	**Rs. 1,09,74,000/-**	**Rs. 2,10,000/-**	**6100002362**	**06 months**

Intending bidders need to register themselves on the IIT Bombay portal i.e. https://portal.iitb.ac.in/vrp/index.jsp to get User ID and Password. Please visit https://portal.iitb.ac.in/vrp/vrp_srm_docs.jsp for configuration process and user manual. For queries regarding vendor registration, and configuration process please contact on 022 - 2159 3001 (MDM Help-desk) and queries regarding to online Bid submission please contact to +91 82915 56277/6377 or mail us at srm@iitb.ac.in

The date and time of submission of the tender documents digitally are from 30.09.2025 to 24.10.2025 till 11:15 a.m. Date of opening of Technical Bid will be 24.10.2025 at 11:30 a.m. and Financial Bid 31.10.2025 **(Tentative)**

Interested contractors/agencies are requested to upload Technical bid and Financial bid on the SRM tendering portal of IIT Bombay.

All contractors/agencies should upload technical bid with the following documents on SRM tendering portal, failing to which their tender will be summarily rejected from the tendering process:

1)Experience of having successfully completed works during the past 7 years ending last day of the month previous to the one in which applications are invited :
Three similar completed works each costing not less than the amount equal to **40%** of estimated cost put to tender,
OR
Two similar completed works each costing not less than the amount equal to **50%** of the estimated cost put to tender
OR
One similar completed work of aggregate cost not less than the amount equal to **80%** of the estimated cost.

NOTE: "Similar work "means Green space audit, Green space quantification, Tree valuation & appraisal.

A detailed summary of the similar works reports needs to be enclosed along with the work order copies for scoring in technical scrutiny.

2) Upload a scan copy of the information in respect of manpower/mandays for above said work must be given in undertaking with official signature and seal/stamp, otherwise tender will be rejected.

3) P. F. registration certificate and P. F. challans of last 12months.

4) (i) ESIC registration certificate and copies of ESIC challans of last 12months. OR (ii) Contractors' all risks insurance (CAR policy) / Mediclaim policy.

5) PAN card.

6) GST registration certificate.

7) Income Tax Returns for the past 03 years i.e. of **2021-22, 2022-23, and 2023-24.**

8) List of Equipment's, Machinery, Tools relevant to works.

9) List of Technical Staff with copies of their Degree/diploma certificate.

10) EMD of Rs. 2,10,000/- in the form of BG/ FDR or DD drawn in the favour of " The Registrar, IIT Bombay"

11) Power of Attorney, if any.

12) Proof of Constitution: An affidavit in case of Sole Proprietorship, Partnership Deed in case of Partnership Firm, Article of Association in case of Private / Public Limited Companies.

13) **Litigation history** of the agency is required to be submitted along with the application.

Technical Eligibility Criteria through Scoring System

In order to qualify for technical eligibility evaluation, the contractor/agency shall demonstrate proven experience in executing projects of comparable nature i.e. as listed in the 'similar work'. The technical eligibility evaluation will be based on a scoring system that considers the scope and depth of analytics carried out in the contractor/agency's previous assignments.

The bidder must provide a summary from previous works reports submitted to clients, clearly highlighting the analytics undertaken in line with the categories mentioned below.

Only the contractor/agency fulfilling the minimum qualifying score will be considered for further evaluation.

Scoring Framework:

S. No.	Category	Maximum Points
1	Spatial Composition and Vegetative Land Use	8
2	Tree Inventory and Structural Metrics	8
3	Vegetation Diversity and Taxonomic Richness	9
4	Ecological Suitability and Vegetation Health	8
5	Green Space Carbon Storage, Biomass & Oxygen Services	8
6	Green Space Pollution Mitigation Services	9
7	Green Space Hydrological Services	9
8	Green Space Microclimate Regulation & Heat Island Mitigation	8
9	Green Space Economic Valuation	8
10	Green Space CO_2-Equivalent Translation	9
11	Green Space Strategic Recommendations and Action Plan	8

12	Green Space Mapping	8
	Maximum Points	**100**
Minimum Required to Qualify: 75 Points		

Note:

Upload all your relevant documents in the serial order mentioned above. It is advisable not to make more than **03 folders of 4MB** while uploading documents.

The work will be executed with lowest bidder as per the terms and conditions of work order and tender documents signed by the lowest bidder. (All agencies are requested to upload a scan copy of Terms and Conditions with official signature and seal/stamp on SRM online tendering portal)

The validity of the bids will be 6 months from the date of opening of the tender.

If any agency fails to submit the above mentioned documents by uploading to the online portal, their technical bid may be rejected.

Litigation history of the agency has to be uploaded along with the application if any. Tender would not be awarded if any inquiry proceeding / criminal case is found pending against the agency.

No work should be subleted to third party. If found the payment of the final bill will not be processed and the contractor's name will be removed from the enlistment without any further notice.

Contractor's/Agencies/Proprietor's are requested to give Power of Attorney to your representative to deal any matter with any Officers or Staff of IIT Bombay on behalf of you or your agency.

Rates of the estimate are based on Market rate analysis.

The contractor has to quote his own rates online against each item of work and need to select **N5 tax code** thereafter.

Scan and upload all the above mentioned documents in **"C folder"** of online SRM tendering protal.

IIT Bombay reserve its rights to reject any or all tenders without assigning any reason and without any reference.

No queries will be entertained within 24 hours prior to the opening of the tender. We kindly request all contractors to upload their quotations well in advance of the submission deadline to ensure a smooth and timely process.

IIT Bombay reserves the right to request a detailed justification of the quoted rates from the lowest bidder, if deemed necessary by the Horticulture-in-Charge. Should the justification provided by the bidder be considered unsatisfactory or unsubstantiated, the Horticulture-in-Charge shall have full authority to reject the bid, irrespective of it being the lowest.

Sr. Technical Supdt. (In-charge, Horticulture)

Green Space Audit - IIT Bombay

HORTICULTURE SECTION

GENERAL TERMS AND CONDITIONS

Scope of work: The contractor shall execute all activities strictly in accordance with the detailed scope of work outlined in the Bill of Quantities (BOQ) and project proposal. The scope includes, but is not limited to: drone-based aerial mapping, GIS-based spatial analysis, detailed biodiversity profiling, vegetation health assessments, ecological service quantification (including carbon sequestration, oxygen production, air pollution removal, water conservation, and microclimate regulation), and the generation of deliverables including analytical reports, geospatial outputs, and strategic recommendations. Any deviation, omission, or expansion of scope must be formally communicated and approved in writing by the authorized representative of IIT Bombay before implementation.

1. **Scientific Methodology:** All analyses, models, and metrics used for green space audit must be scientifically validated and derived from globally accepted frameworks such as the IPCC Guidelines for National Greenhouse Gas Inventories, i-Tree Eco Protocols, CTLA Tree Valuation Methods, UNEP's ecosystem service valuation models, and relevant IS standards. The contractor must provide full documentation and citations for each methodology used, including equations, conversion factors, references, and software versions. The audit must be transparent, reproducible, and independently verifiable.

2. **Ground Control Points (GCPs):** To ensure centimeter-level spatial accuracy in orthomosaic and elevation outputs, the contractor must establish Ground Control Points across the campus using GNSS receivers with sub-meter accuracy. GCPs should be evenly distributed and permanently marked for reference. GCP data must be submitted with attributes including coordinate system, accuracy, and placement photographs, and used for geo-referencing all spatial outputs.

3. **GIS-Compatible Deliverables:** All geospatial outputs must be prepared in industry-standard formats that are fully compatible with popular GIS platforms such as QGIS, ArcGIS, and Google Earth. Formats shall include: Orthomosaic images (GeoTIFF with coordinate metadata) or Parcel vector layers (SHP and GeoJSON) or Tree and vegetation point data (CSV and KMZ) or Contour and canopy height maps (DXF, TIF). Each file must be well-documented with accompanying metadata, including coordinate reference system (CRS), datum, unit of measurement, and source.

4. **Orthomosaic Image Standards:** The contractor must produce high-resolution orthomosaic images of the entire vegetated area of the campus using drone-captured images stitched through photogrammetric software. The orthomosaic must have a minimum resolution of 3–5 cm/pixel (GSD) and include both nadir (top-down) and oblique angles to capture tree crown structure. Orthomosaics must be color-balanced, distortion-free, and georeferenced using the established GCP network. Oblique images must be submitted separately to support canopy visualization.

5. **Ground Truthing Protocol:** To validate the accuracy of remotely sensed outputs (e.g., canopy outlines, parcel boundaries, vegetation types), the contractor must undertake a rigorous ground truthing process. At least 10% of all mapped features must be physically verified in the field.

6. **Vegetation Parcel Database:** The contractor shall create a structured spatial database covering all green space parcels delineated within the 489-acre IIT Bombay campus. Each parcel record shall include: area (m²), vegetation type (e.g., turf, trees, herbs, shrubs), canopy density, number of individual trees, biodiversity indices, Leaf Area Index (LAI), biomass estimates, carbon stock (above-ground and below-ground), health index, and ecological service contributions. The database must support parcel-wise, species-wise, and layer-wise querying.

7. **Unique Area Categorization and IDs:** Each tree, vegetation patch, or spatial point recorded must be assigned a unique alpha-numeric identifier, linked to its precise GPS location and corresponding parcel code. These identifiers must be consistently used across tables, GIS layers, photographs, and reports. A tag legend must be included, detailing the format, label type, and ID assignment logic.

8. **Data Format Standards:** All data must be submitted in standardized, interoperable formats. These include: Text documents in DOCX and PDF, Data tables in XLSX and CSV, Maps in SHP, KML, KMZ, GeoJSON, Raster files in GeoTIFF, 3D models or profiles (if any) in OBJ,FBX,orDXF.All data must include metadata descriptors (date, CRS, units, equipment used) and source references for traceability and audit.

9. **Visual Documentation:** Each spatial unit (parcel) must be documented through photographs capturing various perspectives. A minimum of five geo-tagged, photographs per parcel must be provided, including: Aerial top view (nadir) or Oblique aerial view, Ground-level vegetation close-up, Photographs must be organized and indexed by parcel ID and uploaded as part of the final deliverables.

10. **Digital Dashboard:** The contractor shall develop an interactive, web-compatible digital dashboard summarizing parcel-wise ecological and structural indicators. It must include tree count, species richness, biodiversity indices, canopy area, LAI, carbon sequestration, oxygen output, and risk indicators. The dashboard must support filtering by parameter, search by parcel ID, and exportable summary tables. The interface must be responsive and accessible for institutional stakeholders.

11. **Data Backup:** All UAV raw footage, imagery, spatial outputs, GIS layers, field logs, and photographs must be securely stored and backed up. One encrypted external hard disk with complete data must be submitted to IIT Bombay as a backup. The contractor must also retain a duplicate copy in secure storage for 12 months after report submission to facilitate post-audit verifications or review.

12. **Ecological Valuation Models:** The contractor must assess and monetize structural value provided by green spaces using globally recognized models such as CTLA Tree Valuation, and other peer-reviewed frameworks. Each valuation must include methodology, per-unit rates, equations, and total economic value in INR per hectare and per annum.

13. **CO_2-Equivalent Translation:** All ecosystem services quantified (e.g., biomass, pollutant removal, water conservation) must be translated into CO_2-equivalent units using IPCC-aligned conversion coefficients. This enables benchmarking of the green space's contribution to institutional climate goals and integration with ESG, BRSR, and carbon finance frameworks. The report must provide annual and cumulative CO_2-equivalent values with breakdowns by service type.

14. **Biodiversity Metrics:** Comprehensive biodiversity profiling must be undertaken using established statistical indices, namely: Shannon-Wiener Index (H'), Simpson's Diversity Index (D), Evenness Index (E). These indices must be calculated for species, genus, and family levels across all vegetative layers. The results should be presented per parcel and as aggregated site-wide metrics, supported by tabulated and graphical outputs.

15. **Vegetation Health Scores:** Vegetation health must be evaluated through a composite scoring system that includes parameters such as canopy density, defoliation, chlorosis, pest infestation, structural damage, soil health indicators (pH, moisture, texture), and Leaf Area Index (LAI). The contractor must assign health scores to each parcel and classify them into categories: Healthy, Moderate Stress, Declining, or Critical. Visual and numeric evidence must support all health classifications.

16. **Pollution Removal Quantification:** The contractor must model the annual removal of common air pollutants—namely $PM_{2.5}$, PM_{10}, NO_x, SO_2, CO, and O_3—by vegetation using scientifically accepted methods. Estimates should be based on leaf surface area, deposition velocities, meteorological data, and canopy characteristics (e.g., LAI, crown porosity). The methodology shall include references to models such as i-Tree Eco or equivalent literature-

backed formulas. Results must be reported in kg/year per pollutant per parcel and expressed as equivalent air purification volumes.

17. **Water Services Assessment:** The green space's contribution to hydrological regulation must be quantified through the following: Rainfall Interception (L/ha/year), Avoided Surface Runoff (m³/year).

18. **Microclimate Analysis:** The contractor shall quantify the green space's role in urban heat island (UHI) mitigation by modeling vegetation-based temperature reduction (in °C), humidity regulation, and UV radiation attenuation. Data sources may include field temperature logs, satellite thermal imagery (e.g., Landsat LST), and literature-based correlations between canopy structure and microclimate parameters. Parcel-wise estimates shall be compiled into a map of UHI mitigation potential and annual CO_2-equivalent benefit.

19. **Nativity and Suitability Assessment:** Every recorded species must be classified as native, naturalized, or non-native/invasive based on regional floristic databases and expert consultations. Suitability must be assessed through a biogeographical alignment score that considers local climate, soil compatibility, and ecological role.

20. **Reporting Requirements:** The final report shall follow a structured format including: Executive Summary, Project Methodology, Parcel Mapping and Vegetative Typology, Tree Census and Structural Metrics, Biodiversity Indices, Health and Nativity Assessment Ecological Service Quantification, CO_2-equivalent Summary, Economic Valuation, Recommendations, Strategic Action Plan. Each section must include tables, graphs, photographs, and GIS references as applicable.

21. **No Unauthorized Subcontracting:** Subcontracting of any core scope components (such as drone operations, biodiversity assessments, carbon valuation, or GIS mapping) is strictly prohibited unless pre-approved in writing by IIT Bombay. If subcontracting is approved, the credentials, previous experience, and liability agreement of the sub-agency must be submitted beforehand.

22. **Campus Behavior:** Contractor personnel must maintain decorum, respect campus rules, and coordinate with campus administration during movement. Work areas must be marked clearly, and public inconvenience should be minimized. Contractor staff shall not enter academic buildings, hostels, or restricted zones without prior permission.

23. **Safety and Insurance:** The contractor is responsible for the occupational safety and personal protection of all deployed personnel.

24. **Injury and Liability:** In the event of injury to any staff member or damage to campus property (including trees, fences, lights, or underground utilities), the contractor will be held fully liable and shall bear all costs of repair, compensation, and administrative penalties, if any.

25. **Compensation for Damage:** Any incidental damage caused to existing vegetation, pavements, or infrastructure due to UAV operations, tagging, field sampling, or foot movement must be rectified immediately. Replantation, compensation, or repair must be completed within 15 working days at the contractor's cost.

26. **Data Ownership:** All primary, processed, and derivative data (e.g., spatial files, tables, models, maps, images, and reports) generated during the audit shall be the exclusive property of IIT Bombay. No reuse, publication, or sharing with third parties is permitted without prior written permission.

27. **Confidentiality:** The contractor shall maintain strict confidentiality of all findings, methodologies, spatial databases, and biodiversity information related to the project. This obligation extends beyond the duration of the contract. Any breach will result in legal consequences and blacklisting.

28. **Legal Jurisdiction:** Any disputes arising from this contract—including interpretation, execution, deliverables, or payments—shall be subject to the jurisdiction of courts located in Mumbai, Maharashtra only.

29. **Documentation Standards:** All documentation—technical or visual—must follow professional standards suitable for institutional archiving. Reports must be formatted with clear headings, captions, units, legends, references, and consistency in terminology. Photographs must be high-resolution and properly labeled.

30. **Submission Protocols:** The contractor shall submit: Two hard-bound copies of the final report, one external hard drive containing all raw and processed data, one cloud-based link to all deliverables (password protected), Submissions must be accompanied by a deliverable checklist signed by the team lead and a handover note from the contractor's authorized representative.

31. **Site Reconnaissance :** The contractor is encouraged to conduct a detailed physical reconnaissance of the IIT Bombay campus prior to submitting a commercial bid. This includes evaluating terrain variability, canopy height variation, shadow effects, building interference, topographic gradients, UAV flight constraints, and accessibility challenges for ground truthing. No request for scope modification or cost escalation based on unanticipated field complexity shall be entertained post award.

32. **Post-award Variation:** Any change in scope of work after the award of contract—whether by enhancement, reduction, or substitution—must be formally issued by IIT Bombay through a written communication. The contractor shall not act on verbal instructions or assumptions. Cost implications (if any) for approved variations shall be evaluated case-by-case and mutually agreed upon prior to execution.

33. **Presentation and Review:** Upon submission of the draft and final reports, the contractor shall present the findings to the designated institutional committee. The presentation shall include methodology justification, major findings, parcel-level summaries, and strategic recommendations. At least two such review sessions are mandatory. The contractor must be prepared to respond to queries from faculty, administrators, and other stakeholders during these sessions.

34. **GIS Compatibility Assurance:** All spatial layers must be submitted in formats tested for compatibility with major platforms including QGIS (open source), ArcGIS Pro, and Google Earth Pro. Vector layers must be properly attributed, topology-correct, and include fields such as ID, Parcel Code, Tree Count, Canopy Area, Health Score, etc. A metadata file describing each GIS layer must be submitted.

35. **Hosting Space and Data Upkeep:** IIT Bombay shall provide the necessary digital infrastructure—either through its institutional website, internal server network, or cloud-based systems—for hosting the final deliverables, including the interactive dashboard, geospatial datasets, summary reports, and visual assets. The contractor shall be responsible for developing and delivering a fully functional, browser-compatible ecological dashboard summarizing green space metrics (e.g., tree count, biodiversity indices, carbon sequestration, pollution removal, nativity, and vegetation health). The institute will allocate suitable server space or web portal embedding options for public or internal access, as determined by its IT policies. The contractor must coordinate directly with IIT Bombay's designated IT team to ensure compatibility with existing platforms, meet required technical standards (such as file size, responsiveness, accessibility, and data security), and complete the dashboard integration within the stipulated timeline. Any cloud access credentials, data syncing protocols, and API integrations required for dynamic data retrieval or visualization must be shared in advance and documented. Ongoing responsibility for content accuracy remains with the contractor until final handover is complete.

36. **Dashboard Integration Coordination:** As part of the deliverables, the contractor shall develop a web-compatible interactive green space dashboard summarizing parcel-wise ecological, biodiversity, carbon, and structural metrics. IIT Bombay shall provide appropriate hosting space or embed provisions within its institutional website infrastructure for integration of this dashboard. The contractor shall ensure that the dashboard meets IIT

Bombay's technical standards and accessibility protocols and must coordinate directly with the IIT Bombay IT department during the final stages of deployment to ensure successful integration, data syncing, and user accessibility. Any web development dependencies, data compatibility issues, or server-side requirements must be communicated at least two weeks before submission.

37. **UAV Permissions :** All necessary permissions for operating drones within the IIT Bombay campus shall be granted by the institute. The contractor is required to submit a comprehensive drone operation request to IIT Bombay well in advance of any proposed UAV activity. This request must include the drone specifications (make, model, sensor type), intended flight zones (with KML boundaries), flight altitudes, expected duration, pilot credentials, and safety protocols. Upon review and clearance by the designated IIT Bombay authority—typically in coordination with the security office, IT services, and administrative heads—formal permission will be issued to proceed. The contractor shall not initiate any UAV deployment without receiving explicit written approval. IIT Bombay reserves the right to deny, modify, or defer flight permissions based on academic schedules, ongoing campus activities, or security considerations. Coordination with relevant institutional departments is mandatory to ensure safe, compliant, and non-disruptive aerial operations.

38. **Action Plan Development:** The final report must include a detailed, phased Implementation Action Plan for improving ecological performance of the campus. It must be tailored to site-specific conditions, covering goals such as: increasing native flora coverage, improving canopy density, restoring degraded patches, addressing stressed trees, and enhancing carbon sequestration. The action plan should specify timelines, performance indicators, and responsible roles. Where non-native or low-performing species are dominant, the contractor must provide a Native Species Integration Plan. This plan shall suggest specific regionally appropriate native species for re-plantation, enrichment planting, or inter planting—based on ecological suitability, carbon potential, canopy structure, and pest resistance. Supporting references or institutional nursery data shall be cited.

39. **ESG and SDG Mapping:**The report must include a matrix mapping each ecological service assessed to relevant ESG indicators and United Nations Sustainable Development Goals (SDGs). At minimum, the following linkages must be addressed: Eg: SDG 13 (Climate Action), SDG 15 (Life on Land), SDG 11 (Sustainable Cities) etc.

40. **Post-report Support:** For a period of 90 calendar days after final report submission, the contractor shall remain available (remotely or in person) to address clarifications, queries, or data interpretation requested by the client. No additional cost shall be claimed for this support period. Any extension, if needed, shall be mutually discussed.

41. **Regulatory Alignment:** All recommendations made by the contractor must be consistent with existing environmental laws, state tree protection rules, and national biodiversity policies. This includes compliance with: Maharashtra Tree Act, Indian Biodiversity Act (2002), MoEFCC and CPCB Green Norms, Local municipal tree authority guidelines.

42. **Digital Tools and Accessibility:** The final dashboard and spatial visualization tools must be mobile-responsive, browser-compatible, and accessible using standard devices. Data visualizations must be exportable in PNG, PDF, and CSV. KMZ and GeoTIFF files must be lightweight and loadable in common map viewers (e.g., Google Earth, Map box).

43. **Penalty for Delay:** If the contractor fails to complete the work within the stipulated timeframe (as per agreement), without documented justification or force majeure conditions, a penalty of 1% of contract value per month of delay shall be imposed, up to a maximum of 5%. After two written warnings, IIT Bombay reserves the right to terminate the contract.

44. **Termination Clause:** IIT Bombay may terminate the contract with immediate effect if: The contractor breaches confidentiality or data ownership clauses, submits plagiarized or manipulated results, commits professional misconduct or data tampering, fails to meet critical milestones despite warnings. In such cases, the contractor shall not be entitled to any further payment beyond work satisfactorily completed.

45. **Annual Ecological Service Calculation:** All ecosystem service values (e.g., carbon sequestration, oxygen production, pollutant removal) must be expressed in annual per hectare terms as well as total site-wise cumulative values. This ensures comparability with other campuses, carbon offset models, and land-use benchmarks.

46. **Ecological Index Scoring:** A composite Ecological Performance Index (EPI) must be developed using weighted scores from: Vegetation Structure (Tree:Turf ratio, LAI), Biodiversity Indices, Carbon Storage and Sequestration, Health Scores, Native Species Percentage, Scores must be normalized (0-100), reported per parcel, and visualized using heat maps or dashboard widgets.

47. **Vegetation Layer Segregation:** Vegetation analysis must be stratified into ecological layers: Tree Canopy Layer, Shrub and Understory Layer, Ground cover and Turf Layer, each layer must be analyzed separately for structural metrics, biodiversity, and ecosystem services, in accordance with the vertical profile of green spaces.

48. **Record Archiving:** The contractor shall archive all field notes, raw datasets, UAV logs, processing workflows, photographic records, and modeling spreadsheets in organized digital folders. These records must be retained for a minimum of two years and must be submitted to IIT Bombay or regulatory bodies if required for auditing or academic use.

Sr. Technical Supdt. (In-charge, Horticulture)

Deliverables:

Note: 1) All the reports must be submitted in both soft and hard copies.
2) All the hard copy of the documents needs to be submitted in 3 sets.

1. Spatial composition and vegetative land use

This category needs to be quantified on how green assets are distributed across the site. It includes total green belt and canopy areas, their proportions relative to the site, and the efficiency ratio between designated green belts and actual vegetative cover. It also maps plant and turf coverage and calculates tree density, offering a clear picture of spatial layout and land-use performance.

2. Tree identification and structural metrics

Need to capture the basic structural framework of the vegetation, including total tree count, leaf area index (LAI), and taxonomic breadth- species, genera, families, and classes. Together, these indicators establish the biological foundation of the green space and help quantify ecological structure and diversity.

3. Biodiversity and taxonomic richness

Biodiversity indices such as Shannon-Weiner and Simpson's should be used to evaluate diversity, dominance, and evenness across species, genera, families, and canopy area. These metrics reflect the ecological balance, resilience, and functional complexity of the vegetation.

4. Ecological suitability and vegetation health

This assessment needs to be made on how ecologically aligned the plant species are with the local environment. It includes native vs. introduced species ratios, habitat compatibility, biogeographic suitability, and ratings of vegetation and soil health-key to understanding ecosystem stability.

5. Carbon storage, biomass, and oxygen services

Under this category the amount of biomass, carbon stored in vegetation, and the oxygen produced through photosynthesis has to be measured. It must include both cumulative and annual figures, emphasizing the role of vegetation in climate regulation and atmospheric balance.

6. Pollution mitigation services

The capacity of the vegetation to absorb or intercept pollutants like PM2.5, PM10, NOx, SO_2, CO, and O_3 has to be measured. It should reflect the air purification function of green spaces and their contribution to public health and air quality improvement.

7. Hydrological services

Evaluation of the role of vegetation in managing water flows, including rainfall interception, runoff reduction, and overall water conservation. It must also include stormwater retention benefits translated into CO_2-equivalent values.

8. Microclimate regulation and heat mitigation

Under this category the cooling, shading, and UV shielding effects of vegetation need to be assessed. It measures tree canopy contributions to reducing localized temperatures and mitigating the urban heat island effect, with climate impacts expressed in CO_2-equivalent terms.

9. Economic valuation

This should reflect the appraised monetary value of the green space based on structural and ecological service contributions such as carbon storage, biodiversity support, and air and water quality regulation.

10. CO_2-equivalent translation

This should translate the ecological services- like carbon sequestration, pollutant removal, and soil carbon increments into standardized CO_2-equivalent units, enabling climate accounting and potential integration with carbon markets or ESG reporting.

11. Strategic recommendations and action plan

The green space audit should include a structured set of science-backed recommendations and an actionable implementation plan aimed at enhancing green space performance, ecological resilience, and regulatory alignment.

These recommendations will be tailored to address site-specific challenges and opportunities- ranging from species diversification, rehabilitation, and native plant integration to structural tree interventions, biodiversity enhancement, and pollution mitigation strategies. The recommendations shall also include prioritization frameworks with timelines where applicable, enabling informed decision-making for phased execution and alignment with IIT Bombay sustainability goals.

Technological/Digital deliverables:

12. High-resolution orthomosaic:
Core deliverables of the green space audit is the production of a high-resolution, geospatially accurate Orthomosaic Image of the entire vegetated area across the approx. 489-acre IIT Bombay campus. This orthomosaic has to be generated by stitching together hundreds of georeferenced nadir images captured during UAV flights, ensures seamless spatial continuity and precision. The resulting composite image will provide a true-to-scale, high-definition visual representation of the campus green space, accurately reflecting canopy contours, tree crown extents, open patches, and spatial relationships with built-up zones to be delivered in GeoTIFF format (raster image embedded with coordinate metadata), the orthomosaic shall be compatible with most GIS platforms and spatial analysis software and a KMZ overlay version shall be provided for easy visualization in platforms like Google Earth.

13. Green space analytics database:
Green space analytics database, which should encapsulate spatial, structural, and ecological data for the entire site as well as for each delineated green space parcel. Database shall include wide array of parameters- tree count, species distribution, canopy dimensions, vegetation health indices, LAI, biodiversity scores, nativity ratios, and carbon sequestration estimates etc. linked directly to georeferenced locations. For every green space parcel, a detailed 2D models shall be developed using drone photogrammetry and structure-from-motion algorithms. These models should provide an immersive and quantitative understanding of vertical vegetation structure, enabling assessment of tree crowns and spatial visualization of canopy layering. The 2D outputs shall be delivered in both GIS-compatible file formats (e.g., SHP, DXF, GeoJSON) and visual-rendering formats (e.g., OBJ, FBX, or PDF snapshots) to allow integration into IIT Bombay website.

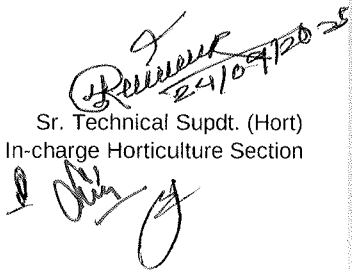**Sr. Technical Supdt. (In-charge, Horticulture)**

EO/A/HORT/WKS-129/25-26

Name of the work: Green space audit in the IIT Bombay campus.

Schedule of Work

Sr. No.	Description of Work	Unit	Qty.
1	Conducting Green Space Audit for the entire vegetation within the IIT Bombay campus, spanning 489 acres with approximately 50 percent green space, involves a scientifically structured, ecologically contextualized evaluation of its vegetative assets and ecosystem services. The audit includes area categorization, mapping, and field survey setup by delineating parcels, classifying habitats, assigning unique IDs, and validating data through GPS and GIS tools, involving manual data collection and ground truthing for accuracy. Quantifying green space distribution involves mapping green belts and canopy cover using drone and aerial imagery integrated with GIS to derive area classifications and calculate green-to-built ratios. Data collection is carried out at the micro level, capturing detailed information on all vegetation layers, including trees, shrubs, herbs, turf, and groundcovers. Undertaking a detailed tree census and biodiversity profiling includes enumerating trees and identifying species to genus and family levels, along with computing Shannon, Simpson, and Evenness diversity indices. Assessing vegetation nativity and suitability includes evaluating native versus introduced species, analyzing biogeographical alignment, and scoring habitat support. Diagnosing vegetation health and assessing soil conditions involves estimating composite health scores, sampling soil for physical, chemical, and biological characteristics, and measuring Leaf Area Index (LAI). Estimating biomass and carbon sequestration includes modelling above-ground and below-ground biomass, quantifying carbon stocks, and calculating both annual and cumulative CO_2 sequestration rates. Estimating oxygen production includes calculating oxygen generation based on species physiology and canopy structure. Quantifying air pollution removal includes modelling the interception and absorption of $PM_{2.5}$, PM_{10}, NO_x, SO_2, CO, and O_3 using foliage characteristics and deposition velocity equations. Evaluating hydrological services includes estimating rainfall interception, avoided surface runoff, and total water conservation, while calculating their CO_2-equivalent benefits. Assessing microclimate regulation and urban heat island mitigation includes analyzing vegetation-based temperature reduction, humidity regulation, and UV radiation attenuation. Accounting for CO_2-equivalent ecosystem services includes aggregating all ecological functions into standardized carbon equivalency values consistent with global climate finance benchmarks. Estimating green space economic valuation includes applying valuation models from ISA, and CTLA to derive monetary values for ecosystem services such as carbon storage, biodiversity enhancement, pollution abatement, and water regulation. Preparing reporting and deliverables includes submitting analytical reports, GIS-based maps, biodiversity and ecological dashboards, valuation spreadsheets, and a comprehensive audit summary; additionally, high-resolution drone imagery of the entire green space will be submitted, along with manually collected ground truth data, as essential components of the final deliverables. Technical support in understanding the deliverables as well. The drone-based aerial survey involving a structured and technologically integrated assessment of the entire green space of the campus thorough site reconnaissance of terrain features, vegetation distribution, and airspace constraints followed by the finalization of flight zones and mapping strategy, including securing necessary drone flight permissions and coordinating with campus authorities for safe and compliant UAV operations. The entire green space to be partitioned into discrete operational phases based on site complexity, canopy height, and ground accessibility enabling precise UAV flight planning and data acquisition. A fleet of high-resolution aerial drones, supplemented with terrestrial close-range photogrammetry tools, to be deployed to capture both top-down (nadir) and angled (oblique) imagery across all zones and low-altitude manual flights are conducted specifically to capture stem widths and canopy morphology for structural analysis. The drone survey to be executed in full alignment with the pre-divided parcels, ensuring systematic and replicable data capture. Ground Control Points (GCPs) to be established to ensure spatial accuracy and georeferencing for all imagery and analytics, enabling generation of orthomosaics, 2D vegetation models, canopy height maps, and other spatial outputs that form the geospatial foundation of the green space audit.	Lump sum	1

1) Note : This schedule of work is given for reference purpose only. Contractors are requested to quote your rates online in financial bid.

2) If you will engage labourer 20 or more any day, you have to get labour licence as per contract Regulation & Abolition Act 1970 Rule 1971, and also, you have to keep all such recored for inspection to the Principal Employer. If you will engage labour up to 10 Nos. per day, you have to file returns after completion of work as per Building & Construction Act to the Office of Regional Labour Commissioner (Central), Sion, Mumbai.

3) This work is to be executed as per the the clauses mentioned in the tender document signed by you.

4) Taxes as per government notification time to time.

5) Contractor must pay GST Taxes to concern authority within 30 days time limit after receipt of payment from IIT Bombay & said record must be submitted to IIT Bombay Accounts Section, otherwise action will be taken as deemed fit.

6) If any malpractices / fraud / negligent professional behaviour or any discrepancy / inconsistency / disparity / deviation / disagreement / dissimilarity / mismatch noticed, their contract will be terminated by issuing one month notice by following legal procedure and will be blacklisted and informed to all Government Authorities and Organisations.

Sr. Technical Supdt. (Hort)
In-charge Horticulture Section

WORKS UNDERTAKING

EO/A/HORT/WKS-129/25-26

To,
Superintending Engineer (I/C)
Indian Institute of Technology,
Powai, Mumbai – 400 076.

   Sub : Green space audit in the IIT Bombay campus.

Dear Sir,
  We are hereby quoting all the rates for the attached schedule of short tender of the above mentioned job.

  We hereby accept & signed all the General Terms and Conditions and special Conditions of Contract.

  The work will be completed within specified time limit of 06 months as mentioned in the notice inviting for short tenders.

  The following information is required to be provided.

  I / We agree to keep the tender open for One Hundred and Eighty (180) days from the due date of its opening / One Hundred and Eighty days from the date of opening of financial bid in case tenders are invited on 2/3 envelope system and not to make any modification in its terms and conditions.

	Male	Female
No. of Unskilled casual labour to be required per day.		
No. of Skilled casual labour to be required per day.		
Total Mandays required for completion of work.		

  Thanking you,

             Yours faithfully,

            Signature of the Contractor
           With official Seal / Stamp of the firm

INDEX SHEET

Sr. No.	Content	Page No.
1	Experience of having successfully completed works during the last 7 years ending last day of the month previous to the one in which applications are invited : Three similar completed works costing not less than the amount equal to 40% of estimated cost put to tender, OR Two similar completed works, costing not less than the amount equal to 50% of the estimated cost put to tender Or One similar completed work of aggregate cost not less than the amount equal to 80% of the estimated cost.	
2	Submit a copy of the information in respect of manpower/mandays for above said work must be given in undertaking with official signature and seal/stamp.	
3	P. F. registration certificate & P. F. challans of last 12months.	
4	ESIC registration certificate and copies of ESIC challans of last 12months. OR Contractors' all risks insurance (CAR policy) / Mediclaim policy.	
5	PAN card.	
6	GST Registration certificate	
7	Income Tax Return for last 03 years i.e. of 2021-22 ,2022-23 & 2023-24.	
8	List of Equipment's, Machinery, Tools.	
9	List of Technical Staff with copies of their Degree/diploma certificate.	
10	Earnest Money Deposit	
11	Power of Attorney, if any.	
12	Proof of Constitution: An affidavit in case of Sole Proprietorship, Partnership Deed in case of Partnership Firm, Article of Association in case of Private / Public Limited Companies.	
13	Litigation history of the agency is required to be submitted along with the application. A tender would not be awarded if any inquiry proceeding / criminal case is found pending against the agency.	

Signature & stamp of the Contractor