

**GOVT. HOLKAR (MODEL AUTONOMOUS)  
SCIENCE COLLEGE, INDORE**



(An ISO 9001:2015 & ISO 14001:2015 Certified Institution)



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2017-18 TO 2021-22

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Audit Report**

तमसो मा ज्योतिर्गमय



**Government Holkar (Model, Autonomous)  
Science College, Indore (M.P.), India**

# Environmental Audit Report

In compliance with statutory requirement under the NAAC accreditation procedures criteria VII

## 2022-23

On Dated: 15<sup>th</sup> to 16<sup>th</sup> Dec 2022

**AUDITED BY**

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**(ISO 9001, 14001, 45001 Certified, MSME & NSIC Registered Company)**

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# Index

| Sr. No. | Point No. | Subject                                       | Page Number |
|---------|-----------|-----------------------------------------------|-------------|
| 1       | I         | Acknowledgement                               | 8           |
| 2       | II        | Disclaimer                                    | 10          |
| 3       | III       | Context and Concept                           | 11          |
| 4       | IV        | Certificate                                   | 12          |
| 5       | V         | Preface                                       | 13          |
| 6       | VI        | History of Indore                             | 14          |
| 7       | VII       | Holkar science college                        | 14          |
| 8       | VIII      | About Holkar science college                  | 15          |
| 9       | IX        | Alumni                                        | 15          |
| 10      | X         | Renowned Alumni of the College                | 16          |
| 11      | XI        | Eminent personalities visiting                | 16          |
| 12      | XII       | Site Plan of Holkar Science College, Indore:  | 16          |
| 13      | XIII      | Departments of Holkar Science College, Indore | 17          |
| 14      | XIV       | Vision, Mission & Goals                       | 18          |
| 15      | XV        | NAAC Rating                                   | 19          |
| 16      | XVI       | Awareness for Environment                     | 19          |
| 17      | XVI       | Library                                       | 19          |
| 18      | XVIII     | Primary health centre & banking               | 20          |
| 19      | XIX       | Other student activities                      | 20          |
| 20      | XX        | Discipline & use of Mobile phone              | 20          |
| 21      | XXI       | N.S.S (National service scheme)               | 20          |
| 22      | XXII      | Timeline of all Departments                   | 20          |
| 23      | XXIII     | The Department of Mathematics                 | 21          |
| 24      | XXIV      | The Department of Physics                     | 21          |
| 25      | XXV       | The Department of Chemistry                   | 21          |
| 26      | XXVI      | The Department of Botany                      | 21          |
| 27      | XXVII     | The Department of Zoology                     | 21          |
| 28      | XXVIII    | The Department of English                     | 21          |
| 29      | XXIX      | The Department of Computer Science            | 21          |
| 30      | XXX       | The Department of Biochemistry                | 21          |
| 31      | XXXI      | The Department of Bioinformatics              | 22          |
| 32      | XXXII     | The Department of Biotechnology               | 22          |
| 33      | XXXIII    | The Department of Fisheries                   | 22          |
| 34      | XXXIV     | The Department of Electronics                 | 22          |
| 35      | XXXV      | The Department of Forensic science            | 22          |
| 36      | XXXV      | The Department of Geology                     | 22          |
| 37      | XXXVII    | The Department of Hindi                       | 22          |
| 38      | XXXVIII   | The Department of Horticulture                | 22          |
| 39      | XXXIX     | The Department of Microbiology                | 23          |
| 40      | XL        | The Department of Pharmaceutical Chemistry    | 23          |
| 41      | XLI       | The Department of Seed Technology             | 23          |
| 42      | XLII      | The Department of Statistics                  | 23          |
| 43      | XLIII     | Pg programs                                   | 23          |

| Sr. No. | Point No.        | Subject                                                                                                       | Page Number |
|---------|------------------|---------------------------------------------------------------------------------------------------------------|-------------|
| 44      | XLIV             | Ph.D. Programs                                                                                                | 23          |
| 45      | XLV              | Effluent treatment plant                                                                                      | 24          |
| 46      | XLVI             | Proposals                                                                                                     | 24          |
| 47      | XLVII            | Photographs                                                                                                   | 24          |
| 48      | XLVIII           | Introduction of Auditing Firm                                                                                 | 25          |
| 49      | XLIX             | Director's & team Details                                                                                     | 26          |
| 50      | L                | List of Instruments                                                                                           | 26          |
| 51      | <b>Chapter 1</b> | <b>Environment Audit</b>                                                                                      | <b>27</b>   |
| 52      | 1.               | Introduction: Environment Audit an Effective Efforts towards Environment Sustainability & Energy Conservation | 28          |
| 53      | 1.1              | Why environment audit                                                                                         | 29          |
| 54      | 1.2              | Goals of Environment audit                                                                                    | 29          |
| 55      | 1.3              | Objectives of Environment audit                                                                               | 29          |
| 56      | 1.4              | About Criteria 7 of NAAC                                                                                      | 30          |
| 57      | 1.5              | Benefits of Environment Audit to an Educational Institute                                                     | 31          |
| 58      | 2                | Water & wastewater audit                                                                                      | 32          |
| 59      | 2.1              | Introduction                                                                                                  | 32          |
| 60      | 2.2              | Importance of Water Audit                                                                                     | 32          |
| 61      | 2.3              | Water audit                                                                                                   | 32          |
| 62      | 2.4              | Water quality                                                                                                 | 33          |
| 63      | 2.4.1            | Drinking water quality                                                                                        | 33          |
| 64      | 2.4.2            | WHO drinking water specifications updated on 11 oct 2019                                                      | 34-37       |
| 65      | 2.4.3            | Water quality in India Source UNICEF Repository                                                               | 37          |
| 66      | 2.4.4            | Iron                                                                                                          | 37          |
| 67      | 2.4.5            | Arsenic                                                                                                       | 38          |
| 68      | 2.4.6            | Chlorine and Fluoride                                                                                         | 38          |
| 69      | 2.4.7            | Nitrate                                                                                                       | 39          |
| 70      | 2.5              | Sewage treatment capacity of states in India                                                                  | 39          |
| 71      | 2.5.1            | Indian Standards for Safe Drinking Water                                                                      | 39-40       |
| 72      | 2.5.2            | Definition of drinking water quality                                                                          | 40-42       |
| 73      | 2.6              | As Per Central Ground Water Board report of September 2013                                                    | 43          |
| 74      | 2.7              | Sample Quality of water in terms of pH, TDS, EC. At Holkar Science College                                    | 44          |
| 75      | 2.7.1            | Test for Bacteria presence in water                                                                           | 44          |
| 76      | 2.7.2            | Test for Copper, Sulphates and Fluorides                                                                      | 45          |
| 77      | 2.8              | Ground water                                                                                                  | 45          |
| 78      | 2.8.1            | Groundwater Quality (Colour, pH, Turbidity, Electrical Conductivity, Total Dissolved Solids,                  | 45-46       |
| 79      | 2.9              | Total dissolved solids                                                                                        | 46          |
| 80      | 2.1              | Quality of ground water for drinking                                                                          | 46          |
| 81      | 2.11             | Quality of water for irrigation                                                                               | 46          |
| 82      | 2.11.1.1         | pH value                                                                                                      | 46          |

| Sr. No. | Point No. | Subject                                                           | Page Number |
|---------|-----------|-------------------------------------------------------------------|-------------|
| 83      | 2.11.1.2  | Alkaline water                                                    | 47          |
| 84      | 2.11.1.3  | Electrical Conductivity of Water                                  | 47          |
| 85      | 2.11.1.4  | Sulphates in drinking water                                       | 47          |
| 86      | 2.11.1.5  | Presence of Copper in water                                       | 48          |
| 87      | 2.11.1.6  | Presence of Fluorides in drinking water                           | 48          |
| 88      | 3         | Water quantity                                                    | 48          |
| 89      | 3.1       | Report                                                            | 48          |
| 90      | 3.2       | Methodology for reduction in water consumption                    | 49          |
| 91      | 3.3       | Broadly speaking, you can reduce your direct water footprint by   | 49          |
| 92      | 3.4       | Measure daily consumption data                                    | 49-50       |
| 93      | 3.5       | Measure the pumping hours                                         | 51          |
| 94      | 3.6       | College water resources                                           | 51          |
| 95      | 3.7       | Water consumption in the College                                  | 51-54       |
| 96      |           |                                                                   |             |
| 97      | 3.8       | Sustainable water practices                                       | 55          |
| 98      | 3.8.1     | Watershed management practices                                    | 55          |
| 99      | 3.8.2     | Wastewater filtration tank                                        | 55          |
| 100     | 3.8.3     | Rainwater harvesting units                                        | 56          |
| 101     | 3.9       | Field Test of Quality of water                                    | 57          |
| 102     | 3.10      | Field Test of Quality of water (Copper, Fluorides, TDS, Hardness) | 58          |
| 103     | 4         | Ambient Air quality audit                                         | 58          |
| 104     | 4.1       | National ambient air quality program (NAAQM)                      | 58-60       |
| 105     | 4.1.1     | Sulphur dioxide (SO <sub>2</sub> )                                | 61          |
| 106     | 4.1.2     | Oxides of Nitrogen (NO <sub>x</sub> )                             | 61          |
| 107     | 4.1.3     | Carbon Monoxide (CO)                                              | 61          |
| 108     | 4.1.4     | Carbon Dioxide (CO <sub>2</sub> )                                 | 61          |
| 109     | 4.1.5     | Formaldehyde (HCHO) As a Hazardous Air Pollutant                  | 61          |
| 110     | 4.1.6     | Total volatile Organic Compounds (TVOC)                           | 62          |
| 111     | 4.1.7     | Particulate matter (PM)                                           | 63          |
| 112     | 4.1.8     | Particulate matter 10 (PM 10)                                     | 63          |
| 113     | 4.1.9     | Particulate matter 2.5 (PM 2.5)                                   | 63          |
| 114     | 4.1.10    | Ozone (O <sub>3</sub> )                                           | 64          |
| 115     | 4.1.11    | Lead (Pb)                                                         | 64          |
| 116     | 4.2       | Ambient Air Quality in the Holkar Science College Campus Area     | 65          |
| 117     | 4.2.1     | AQI Chart                                                         | 65-67       |
| 118     | 5         | Waste Management                                                  | 68          |
| 119     | 5.1       | Objectives                                                        | 68          |
| 120     | 5.2       | Solid Waste Management                                            | 68          |
| 121     | 5.2.1     | Campus Solid Waste Management Program                             | 68          |
| 122     | 5.2.2     | Producing less wastes                                             | 68          |
| 123     | 5.2.3     | Methods of solid waste disposal and management                    | 69          |
| 124     | 5.2.4     | The 7 R's of Recycling                                            | 69          |

| Sr. No. | Point No. | Subject                                                                     | Page Number |
|---------|-----------|-----------------------------------------------------------------------------|-------------|
| 125     | 5.3       | Municipal solid waste                                                       | 69          |
| 126     | 5.4       | Plastic waste                                                               | 70          |
| 127     | 5.5       | Centralized online portal                                                   | 71          |
| 128     | 5.6       | Environmental compensation                                                  | 71          |
| 129     | 5.7       | Committee to Recommend Measures                                             | 71          |
| 130     | 5.8       | Construction & Demolition waste                                             | 71          |
| 131     | 5.8.1     | Construction and Demolition waste management                                | 71          |
| 132     | 5.8.2     | Recycle the Construction and Demolition waste                               | 72          |
| 133     | 5.9       | Solid Waste Audit                                                           | 72          |
| 134     | 5.10      | Generation of solid waste in Holkar Science College                         | 73          |
| 135     | 5.11      | Status of solid waste generation in Holkar Science College Campus           | 73-74       |
| 136     | 5.12      | E-Waste                                                                     | 75          |
| 137     | 5.12.1    | Importance of e-waste management                                            | 75          |
| 138     | 5.12.2    | Five Reasons Why E-Waste Recycling is Important                             | 75          |
| 139     | 5.12.3    | It's critical to keep electronic waste out of landfills                     | 75          |
| 140     | 5.12.4    | Electronic products                                                         | 76          |
| 141     | 5.12.5    | Reclaiming valuable materials                                               | 76          |
| 142     | 5.12.6    | Using recycled material                                                     | 76          |
| 143     | 5.12.7    | Discarded electronic devices                                                | 76          |
| 144     | 5.12.8    | Single use Plastic restriction in campus Area                               | 76          |
| 145     | 6         | Hazardous waste management                                                  | 76          |
| 146     | 6.1       | Chemical Lab Waste Disposal for Colleges                                    | 76          |
| 147     | 6.2       | Chemical Lab Waste at Holkar Science College                                | 77          |
| 148     | 6.2.1     | Chemical Lab Waste disposal at Holkar Science College                       | 77          |
| 149     | 6.2.2     | Waste Bins and Controlled Waste Disposal                                    | 78          |
| 150     | 6.2.3     | Risks of Improperly Handled Lab Waste                                       | 78          |
| 151     | 6.2.4     | Environmental Hazards from Improperly Handled Lab Waste                     | 78          |
| 152     | 6.2.5     | Workers impact proper lab waste disposal                                    | 79          |
| 153     | 6.2.6     | Risk of Serious Injuries from Mis-managed Lab Waste in College/Universities | 79          |
| 154     | 6.2.7     | Responsibilities                                                            | 80          |
| 155     | 6.2.8     | Procedure                                                                   | 80          |
| 156     | 6.2.9     | Objectives                                                                  | 80          |
| 157     | 6.3       | Practice adopted in India                                                   | 80-82       |
| 158     | 6.4       | Treatment, storage and disposal facility for hazardous and other wastes     | 82          |
| 159     | 7         | Acid from Labs                                                              | 83          |
| 160     | 7.1       | Disposal of Acid in a Lab                                                   | 83          |
| 161     | 7.1.1     | How to dispose of acid solutions                                            | 83          |
| 162     | 7.1.2     | Types of Waste Generated from a Lab                                         | 83          |
| 163     | 7.1.3     | Handling and Disposal of Laboratory Waste                                   | 83          |
| 164     | 7.1.4     | Types of laboratory waste                                                   | 83          |
| 165     | 7.2       | Disposal of proper chemical hazardous waste in the laboratory               | 84          |

| Sr. No. | Point No. | Subject                                                                       | Page Number |
|---------|-----------|-------------------------------------------------------------------------------|-------------|
| 166     | 7.2.1     | Caps and closure                                                              | 84          |
| 167     | 7.2.2     | Responsibilities                                                              | 84          |
| 168     | 8         | Bio-medical waste                                                             | 84          |
| 169     | 8.1       | Types of Bio-medical waste                                                    | 84-86       |
| 170     | Chapter 2 | Energy Audit                                                                  | 87          |
| 171     | 9         | Energy audit                                                                  | 88          |
| 172     | 9.1       | Resource of Energy Audit                                                      | 88          |
| 173     | 9.1.1     | Energy audit objective                                                        | 88          |
| 174     | 9.1.2     | Primary                                                                       |             |
| 175     | 9.1.3     | Secondary                                                                     |             |
| 176     | 9.1.2     | Source of Energy                                                              | 88          |
| 177     | 9.1.3     | Secondary                                                                     | 88          |
| 178     | 9.2       | Source of Energy                                                              | 89          |
| 179     | 9.3       | Indirect Benefits of Energy Audit                                             | 89          |
| 180     | 9.4       | Details of Connected Load (kw) Till last year Audit                           | 89          |
| 181     | 9.5       | The Audit conducted on 15th & 16th Dec 2022 showed following changes          | 89-100      |
| 182     | 9.6       | Analysis of Energy data                                                       | 100         |
| 183     | 9.6.1     | Indoor lightings                                                              | 100         |
| 184     | 9.6.2     | Outdoor lightings                                                             | 101         |
| 185     | 9.6.3     | Fans                                                                          | 101         |
| 186     | 9.6.4     | Air conditioners                                                              | 102         |
| 187     | 9.6.5     | Submersibles                                                                  | 102         |
| 188     | 9.6.6     | Overall analysis                                                              | 103         |
| 189     | 9.7       | Observation                                                                   | 103         |
| 190     | 9.7.1     | Lighting system                                                               | 104         |
| 191     | 9.7.2     | Lamps                                                                         | 105         |
| 192     | 9.7.3     | Incandescent lamps                                                            | 105         |
| 193     | 9.7.4     | Reflector lamps                                                               | 105         |
| 194     | 9.7.5     | Gas discharge lamps                                                           | 105         |
| 195     | 9.7.6     | Representation of Percentage Wattage Consumption                              | 105         |
| 196     | 9.7.7     | Observation                                                                   | 105         |
| 197     | 10        | Energy Conservation and Renewable energy                                      | 105         |
| 198     | 10.1      | Renewable energy                                                              | 105         |
| 199     | 10.2      | Renewable energy (solar) analysis                                             | 105         |
| 200     | 10.3      | Exemplary performance in reducing Power Consumption in Holkar Science College | 106-107     |
| 201     | 10.3.1    | Energy management strategy                                                    | 108         |
| 202     | 10.3.2    | College corporate approach                                                    | 108         |
| 203     | 10.3.2.1  | Designate an energy manager                                                   | 108         |
| 204     | 10.3.2.2  | Setup an energy monitoring and reporting system                               | 108         |
| 205     | 10.4      | Implement a staff awareness and training program                              | 109         |
| 206     | Chapter 3 | Green Campus audit                                                            | 110         |
| 207     | 11        | Biodiversity audit                                                            | 111         |
| 208     | 11.1      | Biodiversity                                                                  | 111         |

| Sr. No. | Point No. | Subject                                                           | Page Number |
|---------|-----------|-------------------------------------------------------------------|-------------|
| 209     | 11.2      | Plantations                                                       | 112         |
| 210     | 11.3      | Landscaping and gardening activities                              | 113         |
| 211     | 11.4      | Maintenance of gardens and landscape                              | 114         |
| 212     | 11.5      | Maintenance of plantations                                        | 115         |
| 213     | 11.6      | House plants                                                      | 116         |
| 214     | 11.7      | Campus involvement                                                | 117         |
| 215     | 11.8      | Environmental conservation program                                | 117         |
| 216     | 11.9      | Protection of biodiversity of flora Fauna associated with college | 117         |
| 217     | 11.10     | Biodiversity of flora fauna associated with in college campus     | 117         |
| 218     | 11.10.1   | Introduction                                                      | 117         |
| 219     | 11.10.2   | Need for biodiversity conservation                                | 118         |
| 220     | 11.10.3   | Fauna survey                                                      | 118         |
| 221     | 11.11     | Pilot fauna survey                                                | 119         |
| 222     | 11.12     | Questionnaire based fauna survey                                  | 120-121     |
| 223     | 11.13     | Result                                                            | 122         |
| 224     | 11.13.1   | Fauna Survey Pilot fauna survey                                   | 122         |
| 225     | 11.13.2   | Some evidence shown for Fauna                                     | 123         |
| 226     | 11.14     | Flora survey                                                      | 123-125     |
| 227     | 11.15     | Discussion                                                        | 125-133     |
| 228     | 12        | Fire fighting                                                     | 133         |
| 229     | 12.1      | Fire safety norms in India                                        | 133         |
| 230     | 12.2      | Measures to assess fire safety                                    | 134         |
| 231     | 12.2.1    | Provide adequate means of escape                                  | 134         |
| 232     | 12.2.2    | Outline clear pathways to exit doors                              | 134         |
| 233     | 12.2.3    | Install smoke detection systems                                   | 134         |
| 234     | 12.2.4    | Maintain smoke suppression systems                                | 134         |
| 235     | 12.2.5    | Conduct regular fire drills                                       | 134         |
| 236     | 12.2.6    | Use flame-retardant materials in interiors                        | 135         |
| 237     | 12.2.7    | Make office accessible to firefighters                            | 135         |
| 238     | 12.2.8    | Keep the building plans handy                                     | 135         |
| 239     | 12.2.9    | Ask the local fire brigade to assess safety                       | 135         |
| 240     | 12.2.10   | Comply with National Building Code                                | 135         |
| 241     | 12.2.11   | Fire Fighting Equipment in Chemistry lab                          | 136         |
| 242     | 12.2.12   | Fire Fighting equipment at staircase                              | 136         |
| 243     | 12.3      | Sanitation & hygiene                                              | 137         |
| 244     | 12.4      | Innovative creation of Holkar College                             | 138         |
| 245     | 13        | Recommendations                                                   | 139         |
| 246     | 14        | References                                                        | 140         |
| 247     | 15        | Certificates                                                      | 141-158     |

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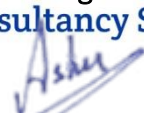
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|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                               |
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| 1. | Dr. Suresh T. Silawat                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <i>Hon'ble Principal, Government Holkar (Model Autonomous) Science College, Indore (M.P.)</i> |
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Date: 15<sup>th</sup> January 2023

Place: Indore

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## Disclaimer

M/s G C Consultancy Services, Environment Audit Team has prepared this report for *Government Holkar (Model Autonomous) Science College, Indore (M.P.)* based on input data submitted by their representatives of college complemented with the best judgment capacity of the expert team and samples collected by our team in presence of college team members.

While all sensible care has been taken in its preparation, details contained in this report have been compiled in good faith based on information gathered.

It is further informed that the conclusions are arrived following best estimates and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Audit Team in this report or for any direct or consequential loss arising from any use of the information, statements, or forecasts in the report.

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**For G C Consultancy Services**



**Proprietor**

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(Lead Auditor ISO 14001-2015,  
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## Context and Concept

In India, the process for environmental audit was first mentioned under the Environment Protection Act, 1986 by the Ministry of Environment and forests on 13th march, 1992. As per this act, every person owning an industry or performing an operation or process needs a legal consent and must submit an environmental reporter statement.

The National Assessment and Accreditation Council, New Delhi (NAAC) has made it mandatory from the academic year 2019–20 onwards that all Higher Educational Institutions should submit an annual Green, Environment and Energy Audit Report. Moreover, it is part of Corporate Social Responsibility of the Higher Educational Institutions to ensure that they contribute towards the sustainable environment.

In view of the NAAC circular regarding environment auditing, the College management decided to conduct an external environment assessment study by a competent external professional auditor.

The term 'Environmental audit' means differently to different people. Terms like 'assessment', 'survey' and 'review' area, so used to describe similar activities. Furthermore, some organizations believe that an 'environmental audit' addresses only environmental matters, whereas others use the term to mean an audit of health, safety and environment-related matters. Al though there is no universal definition of Environment Audit, many leading companies/institutions follow the basic philosophy and approach summarized by the broad definition adopted by the International Chambers of Commerce (ICC) in its publication of Environmental Auditing (1989).

### *The ICC Defines Environmental Auditing as:*

"A management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organization, management and equipment are performing with the aim of safeguarding the environment and natural resources in its operations/projects."

This audit focuses on the environment legal compliances and implementation of rules defined by MoEF&CC or CPCB, state pollution control board. The concepts, structure, objectives, methodology, tools of analysis are objectives of the audit are discussed below.

## CERTIFICATE

This is to certify that a detailed “**Environment Audit, Energy Audit & Green Campus Audit**” for *Government Holkar (Model Autonomous) Science College, Indore (M.P.)* has been conducted at its campus for the academic year 2021-2022 on 15<sup>th</sup> & 16<sup>th</sup> of December 2022. The audits were conducted in accordance with the applicable standards prescribed by the M.P State Pollution Control Board, Central Pollution Control Board (CPCB), New Delhi, and the Ministry of Environment, Forest, and Climate Change, (MoEF&CC), New Delhi. The audit involves Water, Air, Wastewater, Energy/ Renewable Energy, Hygiene, Sanitation, Green inventory, solid waste, plastic waste, and sewage waste etc., and given an '**Environmental Management Plan**' (EMP), which the college may follow to minimize the impact on the institutional working framework. In an opinion and to the best of our information and according to the information given to us, said Environment and it gives a true and fair view in conform, it with environmental audit in principles accepted in India.

Date: 15<sup>th</sup> January 2023

Authorized Signatory & Seal  
For G C Consultancy Services



Proprietor

Place: Gorakhpur

G C Consultancy Service, Gorakhpur

## Preface

Indore is the cleanest city in India according to Swachh Survekshan Report 2022 sixth time in a row, conducted by MoHUA the world's largest urban sanitation and cleanliness survey. Indore has been selected 1<sup>st</sup> out of the 100 Indian cities to be developed as a smart city under the Smart Cities Mission. **Indore received 6 awards in different categories in the India Smart Cities Awards contest organized by the Union Ministry of Housing and Urban Affairs at Surat, Gujarat on 18th April, 2022.** Indore has been part of Swachh Survekshan since its inception and had ranked 25th in 2016. It has been ranked as **India's cleanest city** six years in a row as per the **Swachh Survekshan** for the years **2017, 2018, 2019, 2020, 2021 and 2022.** Meanwhile, Indore has also been declared as India's first 'water plus' city under the **Swachh Survekshan 2021.** Indore became the only Indian city to be selected for International Clean Air Catalyst Programs. The project with cooperation of Indore Municipal Corporation and Madhya Pradesh Pollution Control Board, will be operated for a period of five years to purify the air in the city. Environment auditing is the process of identifying and determining whether in situations practices are eco-friendly and sustainable. In objective to carryout agreed, audit is to check environment, sanitation & hygiene greenery followed by the college and to conduct a well-formulated audit report to understand where the college can optimize the uses of waste material as well as reduce its consumption of electricity and water. The initiative taken by *Government Holkar (Model Autonomous) Science College, Indore (M.P.)* to conduct an **Environment Audit** of the college campus is a commendable sustainable goal. The strategies followed were the preparation of questionnaires and subsequent action plans to implement the project. Questionnaires prepared to conduct the green audit were based on the guidelines, rules, acts, and formats set by the Government of India, Ministry of Environment Forest & Climate Change, New Delhi, and Central Pollution Control Board, New Delhi. Questionnaires were prepared for solid waste, energy, water, hazardous waste. For audit purposes, analysis of suitable data is required, for the same study area is grouped into various Blocks and Departments. The audit was carried out for solid waste, electricity and energy, water and wastewater, hazardous waste, air quality, and green inventory including carbon footprints. It also indicates the green initiatives taken by universities to save environmental resources.

## HISTORY OF INDORE

Indore is a historical city which used to be the capital of the erstwhile Holkar state. Queen Ahilya Devi was a great custodian of religion who constructed several temples across the country. Indore is well known for arts, sculpture and culture.

The history of Indore reveals that the ancestors of the founders of the city were the hereditary Zamindars and indigenous landholders of Malwa. The families of these landlords led a luxurious life. They retained their possessions of royalty, including an elephant, Nishan, Danka and Gadi even after the advent of Holkar. They even retained the right of performing the first pooja of Dussehra (Shami Pujan). During Mughal rule, the families were granted confirmatory sanads by the Emperors Aurangzeb, Alamgir and Farrukhsiyar, confirming their 'Jagir' rights.

Indore, located in the Western region of Madhya Pradesh, is one of the most important commercial centers of the state. The rich chronological history of Indore is worth considering. Even in the days of yore it was an important business hub. But today, with the entry of the corporate firms and institutions, it has earned a major name in the commercial sector of the country. As the story goes, Malhar Rao Holkar of the Holkar clan, received Indore as part of his booty in the conquest of Malwa in 1733. His descendants, who formed the core part of Maratha confederacy, came into conflict with the Peshwas and Scindias and continued the gory battle. There was a sharp turn in the History of Indore with the advent of the East India Company. The Holkars of Indore took part in the battle against the Britishers in 1803. Their glory was razed to dust when they were finally beaten in the Third Anglo Maratha war IN 1817- 1818. The Holkar dynasty had to admit defeat and give up a large portion of the territories under them. Matters came to an extreme when the English started intervening in their succession right. Two of the successors abdicated under mysterious circumstances. The History of Indore became murkier and dark as days went by till the independence of India when in 1947 the state came under the dominion of India.

There are several artistic sculptors in and around the city worth seeing - Rajwada, Lalbagh palace, Sheesh Mahal to name a few. Indore is now recognized as an educational hub in central India that can boast of having both IIM and IIT within its precincts. The city of Indore shares its border with well-developed industrial towns like Dewas & Pithampur. Several well-known industry houses like- Kirloskar, Eicher, Tata International, L&T, Mahindra, Man Force Trucks, Volvo, Cipla, Ranbaxy, Ruchi Soya, Bridgestone and Multinational Companies like TCS, Infosys, Reliance and Sahara have either started their operations or are ready to launch them very soon. In view of its immense industrial potential and profuse techno-based infrastructure Indore is beginning to be recognized as "Mini Mumbai". There are some famous tourist's spots at an average distance of 80 KM from the city among them –The Mahakal temple of Ujjain, Shiva temple at Omkareshwar (both jyotirlinga), Maheshwar the first capital of the Holkar state, historical Mandu fort are worth-mentioning.

## HOLKAR SCIENCE COLLEGE

Govt. (Model, Autonomous) Holkar Science college, Indore was established by the then King of erstwhile Holkar state, Hon'ble Maharaja Shivaji Rao Holkar, in June 1891. The visionary king selected Mr. Cholmondeley from the UK as its first principal. The college started with the best talent available in teaching in India and abroad. At the opening of the new building of the college, the manager of the state stressed the need for girls' education. The king could foresee that conservatism and dogmatic religious beliefs would soon give way to scientific outlook and rationalism. With the increasing number of students and multiplication of disciplines, the college was split into two separate and independent units. One of these two colleges was designated as Govt. Arts and Commerce College while this college retained its prestigious original name i.e., Holkar College and continued to be housed in the old college building.

In the year 1985, the Government Holkar Science College, Indore was awarded the title of a Model College by the state Government of Madhya Pradesh and in the year 1988 the college earned the status of an autonomous college.

## About Holkar Science College

Govt. Holkar Science College, Indore is a prominent college of the state of Madhya Pradesh. Students from all over the state and the neighboring areas covet admission to this prestigious co-ed institution. The college is committed to adhering to its original motive of "widening the horizon for the people" by means of imparting to them adequate education. The college envisions the all-round development of its students as mature and thoughtful human beings and responsible citizens of our country. The mission of the institution is to widen the mental horizon of its students by means of qualitative, value-aided and career-oriented education so that they may cope well with the emerging competitive world of science and policies.

During its journey, the college remained affiliated to Calcutta and Allahabad Universities. At present it is affiliated to Devi Ahilya Vishwavidyalaya (DAVV), Indore which has recently been accredited as "A" grade university by the NAAC, Bengaluru. The college has also been accredited as "A" grade by NAAC in the year 2016.

In view of the quality of education provided by the college, the Govt. of M.P. recognized this college as a model college in 1985-86. In 1989, the UGC found it fit to be an autonomous college and ever since then the college has been a full-fledged autonomous institution (in both at UG and PG levels). In the 2001-02 session, it was also given the status of being a "Center for Excellence" by the Government of Madhya Pradesh Govt.

The college campus is surrounded by a boundary wall that covers an area of about 35 acres of lush green land. The college imparts education in various fields of science both at UG and PG levels. All these courses have been duly affiliated to DAVV. The college offers undergraduate (B.Sc.) program with 23 different subject combinations, postgraduate (M.Sc.) program in 16 subjects and M.Phil. and Ph.D. in 6 subjects respectively. The college also runs IGNOU study center and PGDCA Bhoj study center which offers several courses at various levels. For slow learners the college holds problem solving sessions/remedial classes. The college also arranges free coaching for the aspirants preparing for various competitive examinations. The college has Vivekanand Career Guidance Cell and a Placement Cell which offer career guidance to the students. In order to facilitate the imparting of quality education, the college keeps updating its laboratories and library all the time. The college has drafted its Research policy, IT policy, green policy, Policy of Professional Ethics Development, Women Empowerment Policy distinctly. Due emphasis is given to the observance of ethical values and enhancement of professional skills. To deal with ragging on the campus, the college follows the zero tolerance anti-ragging policy of the State Government. To instill spirit of social service, discipline and patriotism, the college has two separate (Men and Women) units of NSS and three units of NCC. An independent Red Cross Cell is also functional on the campus. Besides these, students are also nominated in various committees where they are exposed to the functioning of the institution, thereby imbibing the qualities of accountability, fearlessness and leadership. Several faculty members of Holkar Science College are nominated on the academic, research and examination committees of the DAVV and other universities. The experience thus gained and shared plays a significant role in the mutual development of the institution.

## Alumni

Ever since its inception the institution has striven hard to fulfill its promises of providing quality education to produce thoughtful, intelligent and competent human beings, capable of facing the challenges of life bravely. The alumni of the college have occupied prestigious positions in almost every walk of life. Perhaps this is the only college which produced Chief Justice of Supreme Court of India, Hon'ble Justice R.C. Lahoti and Chief Justice of Pakistan Hon'ble Justice Alvin "Bobby" Robert Cornelius. The father of Justice Cornelius was a faculty member of the college. At present, the institution is imparting education in science with the emphasis on scientific research.

## Renowned Alumni of the College

35th Chief Justice of India - Justice Shri Ramesh Chandra Lahoti

EX MLA - Shri Ashwin Joshi

Seating MLA for second time and EX Health Minister - Shri Mahendra Hardia

Collector - Dist. Barwani - Shri Jagdish Malpani (IAS)

Ph.D. Scholar at DARTMOUTH, USA - Shri Yashodhan Chinchore

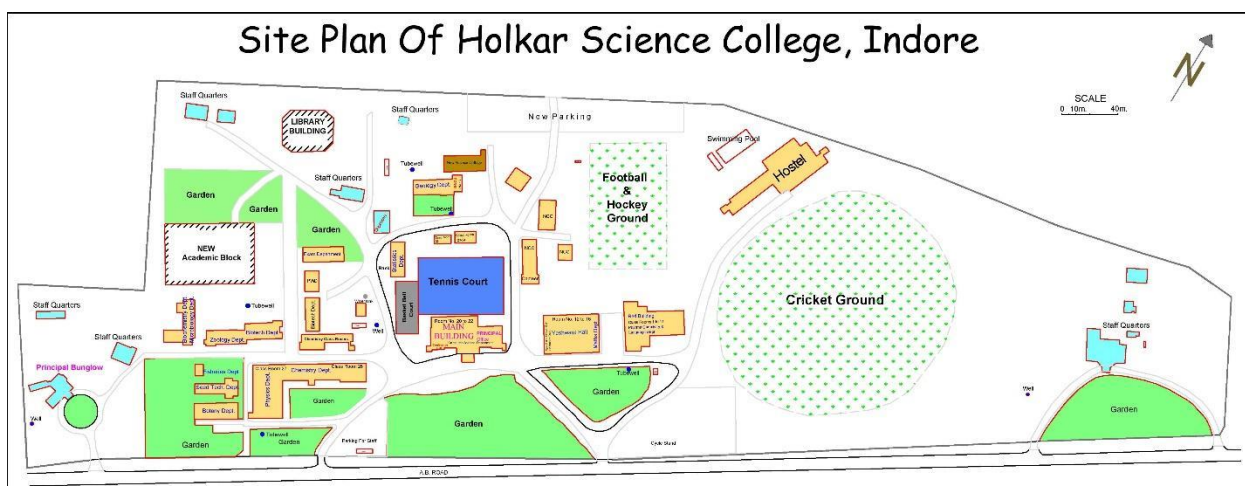
Dy. Collector Indore - Smt. Kirti Khurasiya

SDM Indore - Shri Santosh Tagore

## Eminent Personalities Visiting

The college has the privilege to be visited by VVIPs like Pt. Jawaharlal Nehru (First Prime Minister of Independent India), Dr. S. Radhakrishnan, Dr. A.P.J. Abdul Kalam (Former President of India), Dr. Shankar Dayal Sharma (Former Vice President of India), Shri L.K. Advani (Former Home Minister of India) and almost all the Chief Ministers of Madhya Pradesh. Besides these dignitaries, the college also witnessed the presence of Shri Prithviraj Kapoor (Actor), Shri Hemant Kumar (Singer), Shri Anil Biswas (Music Director), Pt. Madan Mohan Malviya (Indian educationist), Shri Shard Joshi (Poet), Mrs. Malti Joshi (Literature) etc. to name a few.

## Site Plan of Holkar Science College, Indore:



## Campus:

Holkar College campus is located in the South area of East Indore. It is situated in an area between known as Bhanwar Kua which has a high concentration of cultural and academic institutions, including the Holkar Science college-Indore, Central Museum, Institute of Management Studies, Crystal IT Park and the Kamla Nehru Zoological Park. The Holkar College HSC has multiple halls throughout the campus along Indore BRTS and various lectures for science students are conducted within these halls, some major buildings are including the Main Building, Red Building, Yeshwant Hall and Chemistry Block Building.

### Faculties and Departments

The College has Chemistry and Physics departments. The institute receives funds from the state but is autonomous with regards to administration and conduct of examinations. The HSC offers several courses in the field of science. HSC's research and teaching are organized within a network of faculties and academic departments which includes:



Holkar Science College Main Entrance

### Departments of Holkar Science College, Indore

- Department of Biochemistry
- Department of Bioinformatics
- Department of Biotechnology & Bioinformatics
- Department of Botany
- Department of Chemistry
- Department of Computer Science
- Department of Electronics
- Department of Entrepreneurship
- Department of Fisheries
- Department of forensic science
- Department of Geology
- Department of Language
- Department of Mathematics
- Department of Microbiology
- Department of Pharmaceutical Chemistry
- Department of Physics
- Department of Seed Technology
- Department of Statistics
- Department of Zoology



## Vision, Mission & Goals

### Vision:

To develop the personality of the students in a holistic way by making them responsible, thoughtful and mature citizens of our country.

### Mission:

To widen the horizon of the students, to enlighten their minds with quality, value-aided, career-oriented education and to ensure the fullest exploitation of their potentials so that they can compete in the era of new thoughts and technology and can serve humanity in a better way.

### Goals:

- To achieve academic excellence.
- To improve infrastructure and facilitate good governance.
- To work for all round personality development of the students.
- To enhance employability of students through skill development.
- To maintain and improve an eco-friendly, green campus.
- To follow the academic calendar in spirit.
- To provide a safe and friendly atmosphere on the campus.
- To inculcate moral and ethical values among students.
- To promote research and innovation.

Govt. Holkar Science College shall strive to impart knowledge in such a manner as to achieve total satisfaction of students, parents, employers, and the society and organizations.



Front of Government Holkar Science College, Indore

The prestigious 131-year-old Government Holkar (Model Autonomous) Science College has an excellent infrastructure, to meet the escalating strength of the students. The institution has well-furnished and sophisticated classrooms, laboratories and other facilities. The Campus is spread over 34.5 Acre of land in lush green, beautiful and serene atmosphere.

|                                     |                                                                                                                                        |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Campus Area:                        | 34.5 Acre                                                                                                                              |
| Academic Block:                     | 2                                                                                                                                      |
| Laboratories:                       | 60+                                                                                                                                    |
| Research Center:                    | 6 (Mathematics, Physics, Chemistry, Botany, Zoology, Biochemistry)                                                                     |
| NCC Units:                          | 2 (2 MP Armed Squadron, 9 MP Armed Squadron)                                                                                           |
| Library:                            | 1                                                                                                                                      |
| Parks:                              | 5 (Butterfly Park, Mushroom Cultivation Garden, etc.)                                                                                  |
| Playing Grounds:                    | 5 Outdoor Grounds (Cricket, Football, Volleyball, Lawn-Tennis, Basketball)<br>3 Indoor Grounds / Court (Badminton, Chess, Carrom etc.) |
| Gym:                                | 1 Open Gym                                                                                                                             |
| Medical Facility:                   | 1 Medical Dispensary                                                                                                                   |
| Staff Quarters:                     | 17 (3 For Faculty & 14 For Staff Members)                                                                                              |
| Hostel:                             | 1 (Boys Hostel)                                                                                                                        |
| Vehicle Parking Grounds:            | 2                                                                                                                                      |
| Bicycle / 2-Wheeler: Parking Stand: | 2                                                                                                                                      |

### NAAC Rating:

The college has been accredited with 'A' grade by NAAC on 19th January 2016, with CGPA 3.23. It is one of the largest Government Science Colleges in the state. The college works under the auspices of the Department of Higher Education, Government of MP and is affiliated to Devi Ahilya Vishwavidyalaya, Indore.

### Awareness for Environment:

The college contributes to sensitizing the students, regarding issues such as gender, environmental-sustainability, human-values and professional ethics. We wish to inculcate these values to produce righteous and truthful individuals, who can think logically and critically, with a scientific bent of mind. We want our students to be successful in different fields and contribute to nation-building. The college is aware of its responsibility towards environmental conservation. Under the Green Policy, a Solid Waste Management System has been installed to keep the environment clean. The college regularly conducts green and energy audits. The Butterfly Park adds uniqueness to the lush green gardens of the college.

The institution has an excellent infrastructure, to meet the escalating strength of the students. There are two Academic Blocks and other buildings with spacious, well-furnished classrooms. Smart-Boards have been installed in all the classrooms. The faculty members take up interactive, instructional techniques and provide quality learning using ICT resources, Learning Management System (LMS) and other e-resources. They take the initiative to keep abreast with the latest technological and academic innovations, which further add to institutional excellence. The College encourages and promotes research projects useful to humanity and to fulfill this it has a Research Wing, two independent new blocks with well-equipped and sophisticated laboratories. The faculty members provide consultancy to external agencies with expertise on specific knowledge. The college has signed MoUs and has collaborations with national and international institutions.

### Library

The fully automated library, with E-Library and internet facility provides remote access to the resources. There are approximately 96,000 books. The objective is to develop the habit of self-study among the students and equip them with skill and knowledge, so that they can accomplish the task and become self-reliant. The Examination Department along with IT Cell adopted innovative practices to upgrade the examination system, thereby adding distinctiveness to the college.

### *Primary Health Centre & Banking:*

A Primary Health Care Centre is situated on the college campus, with basic medical facilities. They have a disabled-friendly campus with ramps. A branch of State Bank of India inside the campus ensures easy banking for all. The college is also a study Centre for IGNOU and Bhoj University.

### *Other Student Activities*

Apart from academic growth, the college is also concerned with the mental, emotional and physical growth of the students. It lays extra emphasis on sports and cultural activities. There are six sports grounds, two outdoor gyms and indoor games facilities. To promote the cultural heritage of the nation, they encourage cultural activities also. The students excel at national and international platforms and bring laurels to the institution. Extension activities like the Red Cross Society, NCC and NSS units are actively engaged in personality development of the students through community service.

### *Discipline & use of Mobile phone:*

The use of mobile phones by the students is prohibited in the classrooms and on the campus. Nevertheless, they can be used in the garden. Dress-Code has been decided for the faculty members. The whole campus is monitored by CCTV cameras. The college takes strict measures to maintain safety and security for all.

### *N.S.S (National Service Scheme):*

The program aims to inculcate social welfare in students, and to provide unbiased service to society. NSS volunteers work to ensure that everyone who is needy gets help to uplift their standard of living and lead a life of dignity. On 24 September 1969, then union education minister V.K.R.V. Rao launched NSS at the 37 universities in all the states. Initially NSS was started in 2 universities of the state and presently 7 universities in the state are running this scheme. The girl's unit of NSS in our College was started in 1998 while the boy's unit was started in 1969.

## Timeline of all Departments

| Department Name          | Establish in Year |
|--------------------------|-------------------|
| Mathematics              | 1891              |
| Physics                  | 1891              |
| English language         | 1891              |
| Hindi Language           | 1891              |
| Chemistry                | 1917              |
| Botany                   | 1943              |
| Zoology                  | 1958              |
| Biochemistry             | 1968              |
| Geology                  | 1968              |
| Electronics              | 1989              |
| Microbiology             | 1990              |
| Pharmaceutical Chemistry | 1992              |
| Fisheries                | 1994              |
| Seed Technology          | 1994              |
| Statistics               | 1999              |
| Computer Science         | 2000-2001         |
| Biotechnology            | 2001              |
| Bioinformatics           | 2002-2003         |
| Forensic Science         | 2013              |
| Horticulture             | 2013              |

**The Department of Mathematics** was started in the year 1891 and is 131 years old. The Department was established parallel to the establishment of the college together with Statistics. It was known as the DEPARTMENT OF MATHEMATICS AND STATISTICS, under the headship of Dr. R. N. Athavale. Statistics was separated as an independent department in the year 1999. New papers were introduced from classical to modern like Topology, Algebra, Operation Research, Numerical Analysis, Functional Analysis. The Department is maintaining closed links and associations with its former members and old students. The faculty of this department has been actively engaged in teaching and research since its inception.

**The Department of Physics** was established in 1891 and the PG Department was started in the year 1951. This is the frontline department in the college. They offer undergraduate as well as postgraduate courses. To encourage the students to pursue higher studies, several students are sent for summer training in premier research institutes. Further, the department is actively engaged in current research, particularly thin films and nano structured materials, Plasma Physics and another thrust area is Materials Science. About 15 students are enrolled for their Ph. D. work under the supervision of faculty members of the department.

**The Department of Chemistry** offers excellent undergraduate B.Sc., post graduate courses in M. Sc. and M. Phil. The department also offers opportunities for [Ph.D.]. The department has one of the best equipped laboratories for research in MP.

Under-Graduate course i.e., B.Sc. was Established in 1917 while post-Graduate course M.Sc. was Established in 1931 and M.Phil. in 2011

**The Department of Botany** is one of the oldest departments of the college. It was established as an undergraduate department in 1943. It was raised to Post Graduate level in 1960 since October 1943 following heads worked for betterment of students and the society. The department started an advanced course i.e., Ph.D. only after receiving recognition as a research center in 1965. M.Phil. was started in 2011. Faculties of this department are determined for the bright future of students and are working wholeheartedly for betterment of students, society and Environment.

**The Department of Zoology** was established with the start of the P.G. program in July 1958. It holds a prestigious position in Holkar Science College as well as in Devi Ahilya Vishwavidyalaya, Indore. It has a reputable status as a research Centre for zoology & provides a long list of research scholars awarded Ph.D. (Nearly More than 250 Ph.D. as nearly 100 M. Phil. awardee so far.

**The Department of English** Language Maharaja Shivaji Rao Holkar established Holkar Science college on 10th June 1891 in the fond memory of his father Shrimant Maharaja Tukoji Rao Holkar, English literature was taught right from the inception. Post-Graduation in English started in 1926 and Prof. Harjeevan Ghosh was appointed as the Head of the Department. Mrs. Sumati Bhandarkar (Bagchi) topped in M.A. English. And in 1934 she was appointed lecturer of English in the college. She has the distinction of being the first lady lecturer to be appointed at Holkar College.

This was the pre-bifurcation state of Holkar college as it was segregated into two colleges. Science faculty was retained by the college and English literature became part of Govt. Arts and commerce College.

**The Department of Computer Science** was established in the academic year 2000-2001. The department since then has endeavored to promote technical education and scientific research in the important and fast-growing branches of computer science and its application. It is an autonomous department under Govt. Holkar Science College affiliated DAVV, Indore with its goal set to produce computer science specialists to meet the universal challenges. More than 100 students are involved in honorary software development for Government and Non-Government organizations. The department has played a key role and initiative to lay WIFI in college for campus wide internet on every desktop and setting latest technology based IT infrastructure in 2004 of global standards.

**The Department of Biochemistry** was established in the month of July in 1968 for Post Graduate Studies. In 2003 Under-Graduate (UG) courses were started by the department. Now the department offers courses

at Under-Graduate and Postgraduate levels. It also offers Ph.D. programs. It enjoys the reputation of being the oldest in the state. The department has established itself as a research Centre with distinction as it has produced fourteen PhDs till date. The department is equipped with the latest gadgets, sophisticated instruments and a rich library.

**The Department of Bioinformatics** was established in 2002-2003 in Holkar Science College for promotion of the teaching of Bioinformatics as one of the subjects at graduate level. In 2013-14 Bioinformatics became an independent department. In addition to regular teaching UG and research, the department has made significant contributions in making the experimental techniques (Structural bioinformatics, System biology, Computational biology) available to teachers at various colleges through workshops and other means. The department aims to make knowledge of Bioinformatics available at reasonable cost for all levels of students.

#### ***The Department of Biotechnology***

The Department of Biotechnology was established in July 2001 for the promotion of courses in Biotechnology as one of the subjects at UG level. In the session 2002-03 Bioinformatics along with Biotechnology was also introduced at graduation level. In 2006-07, PG courses were started in affiliation with Devi Ahilya Vishwavidyalaya, Indore. In addition to regular (UG and PG) courses and research, the department has made significant contributions in making the experimental techniques (Biochemistry, Hematology and Immunology) available to teachers at various colleges through workshops and other means.

**The Department of Fisheries** was established on 20th July 1994 with the Graduation level study. This subject was started as a vocational course of UGC. In 2013 Post graduate Courses as M.Sc. in Fisheries was Started by self-finance.

**The Department of Electronics** was established in the year 1989. Originally, it was a division of the Department of Physics. It became self-contained in the year 2001. The department of electronics was formed as a self-supporting department in order to provide quality of education to the students at a reasonable fee structure.

**The Department of Forensic science** has shaped the world of justice, fueled crime investigations and signifying the progress of modern or advanced technology.

In 2011 the College decided to introduce Forensic Science as a new subject at Postgraduate level. Department of Higher Education M.P. Bhopal has permitted students to start the course at Postgraduate level. Dr. Vijay R. Chourey Professor of Chemistry has been appointed the Head of the Forensic Science department. After approval of ordinance by Devi Ahilya Vishwavidyalaya Indore, and syllabus by Board of studies, University has granted affiliation to the course in 2013.

**The Department of Geology** was established in July 1968 with the UG program. The PG program was started in July 1982. It is the only post graduate department in the jurisdiction of Devi Ahilya Vishwavidyalaya, Indore. The teaching of Geology was initiated in the Holkar Science College at the undergraduate level in 1967. Postgraduate teaching started in 1984. The college offers B.Sc. course with Geology as one of the subjects and M.Sc. course in Geology.

**The Department of Hindi** Language Holkar Science College was established on June 10, 1891, since then Hindi language is being taught under the Department of Languages. From graduation level, all the students study Hindi language under the basic curriculum, Hindi department remains active throughout the year to create attachment towards Hindi among science students through teaching as well as many literary and educational activities. Shri Gajanan Madhav Muktibodh, the famous poet of Hindi; Gems like famous satirist Mr. Sharad Joshi and senior litterateur Mr. Suryakant Nagar are the gifts of this college.

**The Department of Horticulture** was established in 2013 with the objective to promote education and research in the field of Horticulture. Course was offered at undergraduate level in different combinations

of science subjects (Horticulture, Seed Technology & Botany). Horticulture deals with the growth of flowers, fruits, vegetables and plants for ornamental purposes. This is also a branch of Botany. This subject was introduced in 2011 and the department was established in 2013.

*The Department of Microbiology* was established in 1990. It produces proficient microbiologists every year. Students represent our college in different fields of microbiology. Presently, Dr. Sanjay Vyas is the head of the department, guiding it very successfully and devotedly. His experience and perfect management are certainly keeping the department on the growing path.

*The Department of Pharmaceutical Chemistry* was established in 1992 with the efforts of Dr. K.K. Chaturvedi. Prof. Dept. of Chemistry, Presently Dr. M.K. Dwivedi is the head of the department. The department offers UG & PG Programs, including teaching theory and practical. The department is equipped with instruments like UV-Visible spectrophotometer, Flame Photometer, Dissolution apparatus, Soxhlet apparatus, Disintegration and Friability apparatus. The department has two laboratories and one smart classroom for practical and theory classes.

*The Department of Seed Technology* was established in 1994. This is a branch of Agricultural science which deals with high quality, higher production, processing, storage, testing and distribution of seed.

*The Department of Statistics* presently runs B.Sc. and M.Sc. Courses in Statistics. The UG course in Statistics was started in 1954 with the Mathematics department. The Statistics department was established and started working as an individual department in the year 1999 with the P.G. Program. Prof. K.B. Rajole was the Founder Head of the Department (1999 - 2005) Presently, the department imparts B.Sc. and M.Sc. courses.

#### PG Programs

The college offers the following subjects at the postgraduate level:

- Biochemistry
- Biotechnology
- Botany
- Chemistry
- Computer Science
- Fisheries
- Forensic Science
- Geology
- Mathematics
- Microbiology
- Pharmaceutical Chemistry
- Physics
- Statistics
- Zoology

#### Ph.D. Programs

The college offers Ph.D. program in the following disciplines:

- Biochemistry
- Bioinformatics
- Biotechnology
- Botany
- Chemistry
- Environmental Sciences
- Geology / Earth Sciences
- language
- Mathematics
- Microbiology

- Pharmaceutical Chemistry
- Physics
- Statistics
- Zoology

**Effluent Treatment Plant:** Installed in 2021 to deal with the effluent of chemicals and waste treatment from labs.

## Proposals

Hall with capacity of 500 persons. (Proposed)

Canteen & Gym. (Proposed)

**प्रदूषण नियंत्रण बोर्ड ने दी नगर निगम को हिदायत**

# कम्पोस्ट खाद रोकने, सीवर सफाई से ही रुकेगी बदबू

**पत्रिका न्यूज नेटवर्क**  
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इंदौर. शहर में फैल रही बदबू को लेकर प्रदूषण नियंत्रण बोर्ड ने प्रारंभिक रिपोर्ट नगर निगम को भेज दी। इसमें शहर के जिन क्षेत्रों में बदबू आ रही है, वहां फिलहाल कम्पोस्ट खाद का उपयोग रोकने और सीवरज लाइनों की सफाई का काम तेजी से करने की हिदायत दी है।

बोर्ड ने बदबू वाले क्षेत्रों की स्थिति व जनता की शिकायतों के आधार पर रिपोर्ट तैयार की। बोर्ड ने बताया है, ठंड के मौसम में हवाएं भारी होने से नीचे रहती हैं, इसलिए गंध तेजी से और दूर तक फैल रही है। हालांकि इसमें किसी भी क्षेत्र में स्थिति खतरनाक होने से इनकार किया है।

**फाइल फोटो**

प्रदूषण बोर्ड की रिपोर्ट अभी नहीं देखी है। जो हिदायत दी होगी, उस पर हरसंभव काम करेंगे।  
**आशीष सिंह, निगमायुक्त**

**होलकर की टीम ने भी किया था उल्लेख**

होलकर साइंस कॉलेज के छात्रों ने भी ट्रेसिंग ग्राउंड में दबे कवरों से बदबू आने का अंदेशा जताया था। हालांकि उन्होंने इसकी जांच किसी अधिकृत एजेंसी से कराने के लिए कहा था।

**पूर्वी और मध्यक्षेत्र में आती रही बदबू**

शनिवार शाम को भी पूर्वी व मध्य क्षेत्र के रहवासी बदबू से परेशान रहे। पूर्वी क्षेत्र के मूसाखेड़ी, तिलकनगर, मनीषपुरी, साकेतनगर, साउथ तुकोगंज, फिल्म कॉलोनी व अन्य क्षेत्रों से बदबू की शिकायतें आती रहीं।

**ये हिदायतें दीं**

1 जनता ने गंध वस्तु के सड़ने से आने वाली गंदी गंध के समान बताई है। शहर में छोटे कम्पोस्ट पिट में कचरे से खाद बनाकर बगीचों व डिवाइडर में उपयोग किया जा रहा है। उससे भी गंध आ सकती है। इनका उपयोग रोका जाए।

तिलकनगर, सविदनगर में अधिकांश लोगों ने सीवरबैंक (जलमल के स्थान) के आसपास आने वाली गंध के समान गंध आने की बात कही है। यहां कई जगह सीवर लाइन भई चोक है। सीवरज लाइनों के साथ ही नालों और नालियों की भी तुरंत सफाई कराने की बात कही है।

2

## होलकर कॉलेज में एफ्लूएंट ट्रीटमेंट प्लांट शुरू

**इंदौर @ पत्रिका.** होलकर साइंस कॉलेज की लैब से निकलने वाला रासायनिक पानी अब जमीन को नुकसान पहुंचाने की जगह लाभ देगा। कॉलेज में एफ्लूएंट ट्रीटमेंट प्लांट लगाया गया है। इसके जरिए लैब से निकलने वाला पानी ट्रीट (साफ) होकर जमीन में जाएगा और भूजल स्तर बढ़ाने में योगदान देगा। कॉलेज के रसायन शास्त्र विभाग ने यह प्लांट शुरू किया है।

**लैब से निकलने वाले रासायनिक पानी से बढ़ेगा भूजल**

प्राचार्य डॉ. सुरेश टी. सिल्लाट, एल.ए. संयोजक प्रो. राजीव दीक्षित और विभागाध्यक्ष डॉ. अनामिका जैन ने इस प्लांट को कॉलेज में होने वाले आगामी नए के वारे के लिए अहम बताते हुए सफाई में नंबर वन शहर के लिहाज से भी महत्वपूर्ण बताया। वरअसल, लैब से निकलने वाले रासायनिक पानी का निपटारा कॉलेज के लिए लंबे समय से चुनौती बना हुआ था। पानी बर्बाद होने के साथ-साथ रसायन जमीन को नुकसान पहुंचा रहे थे। प्रो. दीक्षित ने बताया, प्लांट में आसान प्रक्रिया के बाद लैब से निकलने वाला दूषित जल पूरी तरह साफ हो जाएगा। इस पानी को पिट के जरिए सीधे जमीन में पहुंचाया जा रहा है जिससे भूजल स्तर में बढ़ोतरी हो सकेगी।

## होलकर कॉलेज : आठ लैब से निकलने वाले रसायनयुक्त पानी को करेंगे शुद्ध, सींचेंगे पौधे

### प्रदेश में पहली बार : न पौधे नष्ट होंगे, न भूमिगत जल प्रदूषित होगा

**दिनेश जोशी | इंदौर**

प्रदेश के सबसे बड़े गवर्नमेंट होलकर साइंस कॉलेज की आठ लैब में प्रयोग (प्रायोगिक कार्य) के दौरान निकलने वाला रसायनयुक्त पानी पहले शुद्ध किया जाएगा। फिर उससे पौधों की सिंचाई की जाएगी, ताकि पौधे नष्ट न हों और भूमिगत जल पर भी नकारात्मक असर न पड़े। वरअसल, होलकर साइंस कॉलेज की 8 लैब में रोज 150 के आसपास छात्र विभिन्न केमिकल के जरिये प्रायोगिक काम करते हैं, जिसके बाद यह पानी बेहद खराब हो जाता है। अब कॉलेज प्रबंधन पहले इसका उपचार करेगा। फिर उसे पौधों में डालेगा। इसके लिए तीन टैंक बनाए जाएंगे। इन टैंक में अलग-अलग प्रक्रिया के जरिये पानी का उपचार होगा। अंतिम प्रक्रिया के बाद पानी पूरी तरह शुद्ध हो जाएगा। यह प्रयोग प्रदेश में पहली बार किसी सरकारी कॉलेज में लागू किया जा रहा है।

**ऐसे होगा पानी का उपचार**

- पहले टैंक में केमिकल युक्त पानी फिल्टर होकर स्टोर होगा।
- दूसरे टैंक में पानी का अलग-अलग रसायनों से उपचार होगा। इसमें पानी में मौजूद अम्लीय-क्षारीय दोनों अशुद्धि हटा दी जाएगी, यानी पानी का पीएच 7 (पानी शुद्धि का पैमाना हाता है, यह सबसे साफ पानी माना जाता है) किया जाएगा।
- तीसरे टैंक में इस पानी को चारकोल और वायु के जरिये रंगीन किया जाएगा। इसके बाद ऑक्सीजन की मात्रा बढ़ाई जाएगी। जिससे पानी पूरी तरह शुद्ध हो जाएगा। इससे किसी भी तरह के नुकसान की आशंका खत्म हो जाएगी।

**3 सदस्यीय कमेटी बनाई**

प्राचार्य डॉ. सुरेश सिलावट के अनुसार कॉलेज में हम 15 से 16 ऐसे बिंदुओं पर काम कर रहे हैं, जो पर्यावरण की दृष्टि से काफी अहम हैं। इनमें यह सबसे अहम प्रोजेक्ट है। इस पर जल्द काम शुरू किया जा रहा है। केमिस्ट्री विभाग की हेड डॉ. अनामिका जैन का कहना है कि यह प्रक्रिया हम जल्द शुरू करेंगे। इसका सबसे ज्यादा फायदा यह होगा कि आठों लैब से निकलने वाली कई लीटर पानी के कारण होने वाला नुकसान नहीं होगा। इसके लिए हमने तीन सदस्यीय कमेटी भी बना दी है।



### Opening meeting with Faculties of Holkar College

#### *Introduction of Auditing Firm*

M/s. G C Consultancy Services, Gorakhpur is ISO:9001, 14001 & 45001 certified, a fast growing committed consultancy firm. It has its unique feature & unlike other organization we don't simply conduct audit and report preparation is done. But we consider all Government norms (Central & State), CPCB, SPCB, NGT and Supreme court guidelines at the time of Audit. The quality and adoption of CPCB, SPCB norms is our commitment. It is one of the fast-growing Organization in Energy audit, renewal energy, water conservation, waste management, air quality services providing company executed several projects covering all the diversified field Sectors & states of India. The Director Being Ex Central Government Officer & having experience of 34+ years and his associate team members are very well experienced in the field of Environment, Energy Audits. The associate team and experts are highly qualified and experienced in the field of diversified Environment Audit and Services. Individual credential of each member in the field of Energy Audit is very rich due to their past association with the very reputed organization of Auditing sectors. The company has Head office at Gorakhpur, Uttar Pradesh.

|                 |                                                                                                |
|-----------------|------------------------------------------------------------------------------------------------|
| Name of Firm    | M/s G C Consultancy Services                                                                   |
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### G C Consultancy Director's & team Details

| Sr. No. | Name                                      | Designation                                                 | Qualification and Technical Experience                                                                                                                    |
|---------|-------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.      | Er. Ashutosh Kumar Srivastava<br>Director | Principal Auditor<br>34+ Years of Experience                | BE (Civil), Lead Auditor ISO 9001, 14001, 22001, 45001, 50001, 17020. IGBC AP, ASSOCHAM GEM CP, Expert in water audit, air audit, waste management.       |
| 2.      | Dr. Anita Srivastava                      | Head for documentation & Preparation of report              | Ph. D (Botany), Rajasthan University, Jaipur. Rajasthan                                                                                                   |
| 3.      | Er. J. K Vyas                             | Energy Auditor<br>12 Years of Experience                    | M. Tech. (Civil), LL. B, M.B.A, PG Dip. In Urban Planning & Development. GRIHA Evaluator, IGBC-AP, , ECBC Expert in BEE, ECBC Master Trainer of BEE (GoI) |
| 4.      | Ar. Shruti Patidar                        | B. Arc & Freelancer                                         | Ex. HOD in Sage University, Indore. Audit Expert for Water & Air Quality                                                                                  |
| 5.      | Mr. Bhim Tiwari                           | Program Officer, Environment Expert<br>15 Years' Experience | MCA from Agriculture University, Allahabad (Prayagraj) in 2005<br>Heading all IT related works                                                            |

M/s G C Consultancy Services Registered in Ministry of Micro, Small & Medium Enterprises (**MSME**) as Micro unit, registered in **NSIC** under Environment Consultancy services.

### List of Instruments

Following are the instrument used at the time of the Environment Audit.

| Sr.No. | Instrument                                   | Make and Sr. No.                                                  |
|--------|----------------------------------------------|-------------------------------------------------------------------|
| 1      | Water testing kits at site                   | Prerana Laboratories                                              |
| 2      | Air Quality test                             | Prana Laboratories                                                |
| 3      | Temperature gun 1 Set (infrared Thermometer) | Cyclops L Portable pyrometers                                     |
| 4      | Lux Meter 1 Set (Digital Lux Meter)          | Fluke lux meter. Conforms to IEC 61010, CAT III 600V safety rated |
| 5      | Flue gas Analyzer                            | Testo 330i: The future of flue gas analysis.                      |

# Environment Audit

# INTRODUCTION

## *1. Environment Audit an Effective Efforts towards Environment Sustainability & Energy Conservation*

Modernization and industrialization are the two important outputs of the twentieth century that have made human life more luxurious and comfortable. Simultaneously, they are responsible for various use of natural resources, exploitation of forest and wildlife, producing passive solid waste, polluting the scarce and sacred water resources, and finally making our mother Earth ugly and in-hospitable. Today, people are getting more familiar with global issues like global warming, greenhouse effect, ozone depletion, and climate change, etc. Now, it is considered as a final call by Mother Earth to walk on the path of sustainable development. The time has come to wake up, unite and combat together for a sustainable environment.

Considering the present environmental problems of pollution and excessive use of natural resources, Hon'ble Prime Minister Shri Narendra Modi ji has declared the Mission of Swachh Bharat Abhiyan. Also, University Grants Commission has mentioned the "Green Campus, Clean Campus" mission mandatory for all higher educational institutes. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent. Govt. of India has issued National Education Policy 2020 and has issued white paper on its policy. Generation coming should be well conversant with the effects and impacts on Environment and Modernization/ Development. Coming generation must know how to make a balance in both.

Environment Audit is the most efficient ecological tool to solve such environmental problems. It is a process of regular identification, quantification, documenting, reporting, and monitoring of environmentally important components in a specified area. Through this process, the regular environmental activities are monitored within and outside of the concerned sites which have direct and indirect impacts on the surroundings. An environment audit can be one of the initiatives for such institutes to account for their energy, water resource use as well as wastewater, solid waste, hazardous waste generation. The environment Audit process can play an important role in the promotion of environmental awareness and sensitization about resource use. It can create consciousness towards ecological balance, values, and ethics. Through the green audit, one can get direction about how to improve the condition of the environment without much affecting the impact on nature.

## 1.1 Environment Audit

Environment auditing is the process of identifying and determining whether an institution's practices are eco-friendly and sustainable. Traditionally, we are good and efficient users of natural resources. However, over the period excess use of resources like energy, water, chemicals are become habitual for everyone especially, in common areas. Now, it is necessary to check whether our processes are consuming more than the required resources? Whether we are handling waste carefully? In fact, as per modern thinking there is waste as such. ***The policy of Waste to Wealth has been the new concept introduced.*** Environment audit regulates all such practices and gives an efficient way of natural resource utilization. In the era of climate change and resource depletion, it is necessary to verify the processes and convert the min to green and clean ones. The environment audit provides an approach for it. It also increases over all consciousness and awareness among the people working in institutions towards an environment.

## 1.2 Goals of Environment audit

Holkar College has conducted an Environment audit & other audits earlier with specific goals as:

- Assess facility of different types of waste management.
- All waste shall be first finding the scope of its use under ***Waste to Wealth policy.***
- Increase environmental awareness throughout campus.
- Identification and documentation of green practices followed by college.
- Identify strengths and weaknesses in green practices.
- Conduct a survey to know the ground reality about green practices.
- Analyze and suggest solutions for problems identified from the survey.
- Identify and assess environmental risk.
- Short-term goal of environment audit program.
- The long-term goal of the environmental audit program is to collect base line data of environmental parameters and resolve environmental issues.
- To motivate staff and student for optimized sustainable use of available resources.

## 1.3 Objectives of Environment audit.

- To examine the current practices which can impact the environment such as water, air, optimum resource utilization, waste management, etc.
- To prepare an Environmental Statement Report on green practices followed by different departments, support services, and administration building.
- To set goals (Short/ Long), vision, and mission for Green practices on the campus.

- To identify and analyze significant environmental issues.
- To establish and implement Environmental Management Plan (EMP) in various departments and review them periodically.
- To assess for better performance in green practices and its valuation.

#### 1.4 About Criteria 7 of NAAC

Universities are playing a key role in the development of human resources worldwide. Government of India through NEP 2020 has framed the policy under which there shall be 4 verticals out of which NAC vertical will be governed for independently assessment of all HEIs. Higher education institutes campus run various activities with the aim to percolate the knowledge along with practical dimension among the society. Likewise, different technological solutions related to the environment are also provided by the higher education institutes. Different types of evolutionary methods are used to assess the problem concerning the environment. It includes Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), Carbon Footprint Mapping, environment audit, etc.

National Assessment and Accreditation Council (NAAC) is a self-governing organization that rated the institutions according to the scores assigned at the time of accreditation of the institution. Environmental Audit has become a mandatory procedure for educational institutes under NEP 2020 and in Criterion VII of NAAC. The intention of the green audits is to upgrade the environmental condition inside and around the institution. It is performed by considering environmental parameters like optimum use of water and wastewater (approach of recycling and reusing of the same) and accounting, energy conservation, possibilities of new/renewable energy, waste management, air, noise monitoring, facilities for females and differentially abled persons etc. for making the institution eco-friendlier.

Students are the major strength of any academic institution. They are also the future of the nation. Hence educating the Practicing green action in any educational institution will inculcate the good habit of caring for natural resources in students. *Many environmental activities like plantation and nurturing saplings and trees, Cleanliness drives, Bird watching camps, no vehicle day, Rainwater harvesting, etc. will make the students good citizens of the country,* Through Green Audit, higher educational institutions can ensure that they contribute towards the reduction of global warming through Carbon Footprint reduction measures.

## *1.5 Benefits of Environment Audit to an Educational Institute*

There are many advantages of Environment audit to an Educational Institute.

- It would help to protect the environment in and around the campus.
- Recognize the cost-saving methods through waste minimization and energy conservation.
- Empower the organization to frame a better environmental performance.
- It portrays a good image of the institution through its clean and green campus.
- More efficient resource management
- To create a green campus
- To enable waste management through reduction of waste generation, solid and waste.
- To create plastic-free campus and evolve health consciousness among the stakeholders.
- Recognize the cost-saving methods through waste minimizing and managing.
- Authenticate conform it with the implemented laws.
- Empower the organizations to frame a better environmental performance.
- Enhance the alertness for environmental guidelines and duties.
- Impart environmental education through systematic environmental management approach and improving environmental standards.
- Benchmarking for environmental protection initiatives.
- Financial savings through a reduction in resource use.
- Development of ownership, personal and social responsibility for the college and its environment.
- Developing an environmental ethic and value systems in youngsters.
- Green auditing should become a valuable to link the management and monitoring of environmental and sustainable development programs of the College.
- Finally, it will help to build a positive impression through green initiatives for the upcoming NAAC visit.

## 2.0 WATER & WASTEWATER AUDIT

### 2.1 Introduction

Water is a precious natural national resource available with affixed quantum. The availability of water is decreasing due to the increasing population of the nation as per capita availability of utilized water is going down. Due to the ever-rising standard of living of people, industrialization, urbanization, demand for fresh water is increasing day by day. The unabated discharge of industrial effluent in the available water bodies is reducing the quality of these ample sources of water continuously. Hence, the national mission on water conservation was declared by the Honorable Prime Minister Narendra Modi as '**Jal Shakti Abhiyan**' and appealed to all citizens to collectively address the problem of water shortage, by conserving every drop of water and suggesting conducting water audits for all sectors of water use. Water audit can be defined as a qualitative and quantitative analysis of water consumption to identify means of reducing, reusing, and recycling water. Water Audit is nothing but an effective measure for minimizing losses, optimizing various uses, and thus enabling considerable conservation of water in their irrigation sector, domestic, power, and industrial sectors. The measurement of water losses due to different uses in the system or any utility is essential to implement water conservation measures in such an establishment.

### 2.2 Importance of Water Audit

- Systematic process.
- May some surprising results.
- Easier to work on solutions when the problems are identified.
- Attracting mechanisms can be put into place.

It is observed that several factors like climate, culture, food habits, work and working conditions, level and type of development, and physiology determine the requirement of water. The community which has a population between 20,000 to 1,00,000 requires 100 to 150 liters per person (capita) per day. The communities with a population over 1,00,000 require 150 to 200 liters per person (capita) per day. As per the standards provided by WHO Regional Office for Southeast Asia Schools require 2 liters of water per student for drinking purposes; 10-15 liters per student for Water-flush toilets. Administration requires (Staff Accommodation not included) 50 liters per person per day.

### 2.3 Water Audit

The College is spread in a sprawling *lush green* campus of **34.5 acres** dotted with buildings of Academic, Administrative and support services. Water usage can be defined as water used for all activities which are carried out on campus from different water sources. This includes usage in all residential halls, academic buildings, on-campus, and

on-grounds. Wastewater is referred to as the water which is transported off the campus. The wastewater includes sewerage; residence water used in cooking, showering, clothes washing as well as wastewater from chemical and biological laboratories which ultimately go down in the sink or drainage system.

## 2.4 Water Quality

Primary Water Quality Criteria for Bathing Waters, in a water body or its part, water is subjected to several types of uses. Depending on the types of uses and activities, water quality criteria have been specified to determine its suitability for a particular purpose. Among the various types of uses there is one use that demands the highest level of water quality or purity and that is termed as "Designated Best Use" in that stretch of water body. Based on this, water quality requirements have been specified for different uses in terms of primary water quality criteria. The primary water quality criteria for bathing water are specified along with the rationale in table 1. PRIMARY WATER QUALITY CRITERIA FOR BATHING WATER (Water used for organized outdoor bathing) CRITERIA 1. Fecal Coliform MPN/100 ml: 2. Fecal Streptococci MPN/100 ml: 2. pH: 3. Dissolved Oxygen: 4. Biochemical Oxygen demand 3-day, 27°C: 500 (desirable) 2500 (Maximum Permissible) 100 (desirable) 500 (Maximum Permissible) Between 6.5 -8.5 5 mg/l or more 3 mg/l or less RATIONALE to ensure low sewage contamination. The desirable and permissible limits are suggested to allow for fluctuation in environmental conditions such as seasonal change, changes in flow conditions etc. The range provides protection to the skin and delicate organs like eyes, nose, ears etc. which are directly exposed during outdoor bathing. The minimum dissolved oxygen concentration of 5 mg/l ensures reasonable freedom from oxygen consuming organic pollution immediately upstream which is necessary for preventing production of anaerobic gases (obnoxious gases) from sediment. The Biochemical Oxygen Demand of 3 mg/l or less of the water ensures reasonable freedom from oxygen demanding pollutants and prevents production of obnoxious gases.

### 2.4.1 Drinking Water Quality

The principal source of water for Indore is through the Narmada River located at 70 kms from the city or groundwater. The ground water of Indore contains Designated Best Use Water Quality Criteria Designated-Best-Use Class of water Criteria Drinking Water Source without conventional treatment but after disinfection:

A. Total Coliforms Organism MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6 mg/l or more Biochemical Oxygen Demand 5 days 20C 2 mg/l or less Outdoor bathing (Organized).

B. Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5 mg/l or more Biochemical Oxygen Demand 5 days 20C 3 mg/l or less Drinking water source after conventional treatment and disinfection.

C. Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4 mg/l or more Biochemical Oxygen Demand 5 days 20° C, 3 mg/l or less Propagation of Wildlife and Fisheries.

D. pH between 6.5 to 8.5 Dissolved Oxygen 4 mg/l or more Free Ammonia (as N) 1.2 mg/l or less Irrigation, Industrial Cooling, Controlled Waste disposal.

E. pH between 6.0 to 8.5 Electrical Conductivity at 25 °C micro mhos/cm Max.2250 Sodium absorption Ratio Max. 26 Boron Max. 2 mg/l.

#### 2.4.2 WHO Drinking Water Specifications Updated On 11 Oct 2019

WHO produces international norms on water quality and human health in the form of guidelines that are used as the basis for regulation and standard setting, in developing and developed countries worldwide. The quality of drinking water is a powerful environmental determinant of health. Assurance of drinking water safety is a foundation for the prevention and control of waterborne diseases. The guidelines developed by WHO are prepared through a vast global consultative process involving WHO member states (India is the member state), national authorities and international agencies, in consultation with the WHO Expert Advisory Panel.

| Parameters                  | Standard limits as per WHO Guidelines (mg/L) |
|-----------------------------|----------------------------------------------|
| Acrylamide                  | 0.0005                                       |
| Alachlor                    | 0.02                                         |
| Aldicarb                    | 0.01                                         |
| Aldrin and Dieldrin         | 0.00003                                      |
| Ammonia                     | 1.5                                          |
| Antimony                    | 0.02                                         |
| Arsenic                     | 0.01                                         |
| Atrazine                    | 0.002                                        |
| Barium                      | 0.7                                          |
| Benzene                     | 0.01                                         |
| Benzo (?) pyrene            | 0.0007                                       |
| Boron                       | 0.5                                          |
| Bromate                     | 0.01                                         |
| Bromodichloromethane (BDCM) | 0.06                                         |
| Bromoform                   | 0.1                                          |
| Cadmium                     | 0.003                                        |
| Carbofuran                  | 0.007                                        |
| Carbon tetrachloride        | 0.004                                        |
| Chlorate                    | 0.7                                          |

| Parameters                     | Standard limits as per WHO Guidelines (mg/L)   |
|--------------------------------|------------------------------------------------|
| Chlordane                      | 0.0002                                         |
| Chloramines                    | 0.5 - 1.5                                      |
| Chloride                       | 200 – 300                                      |
| Chlorine                       | 5                                              |
| Chlorite                       | 0.7                                            |
| Chloroform                     | 0.3                                            |
| Chlortoluron                   | 0.03                                           |
| Chlorpyrifos                   | 0.03                                           |
| Chromium                       | 0.05                                           |
| Color in drinking water        | No visible color                               |
| Copper                         | 2.0                                            |
| Cyanazine                      | 0.0006                                         |
| Cyanide                        | 0.07                                           |
| 1,2-Dichlorobenzene            | 1.0                                            |
| 1,4-Dichlorobenzene            | 0.3                                            |
| 1,2-Dichloroethane             | 0.03                                           |
| Dichloromethane                | 0.02                                           |
| 2,4-Dichlorophenoxyacetic acid | 0.03                                           |
| DDT and metabolites            | 0.001                                          |
| Di(2-ethylhexyl) phthalate     | 0.008                                          |
| 1,2-Dichloroethylene           | 0.05                                           |
| 1,2-Dichloropropane            | 0.04                                           |
| Dimethoate                     | 0.006                                          |
| 1,4-Dioxane                    | 0.05                                           |
| Dissolved oxygen               | No health-based guideline value is recommended |
| Eidetic acid (EDTA)            | 0.6                                            |
| Endrin                         | 0.0006                                         |
| Epichlorohydrin                | 0.0004                                         |
| Ethylbenzene                   | 0.3                                            |
| Fenoprop                       | 0.009                                          |
| Fluoride                       | 1.5                                            |
| Hexachlorobutadiene            | 0.0006                                         |
| Iron                           | No health-based guideline value is proposed    |

| Parameters                   | Standard limits as per WHO Guidelines (mg/L)     |
|------------------------------|--------------------------------------------------|
| Isoproterenol                | 0.009                                            |
| Lead                         | 0.01                                             |
| Lindane                      | 0.002                                            |
| Manganese                    | 0.4                                              |
| Mercury                      | 0.006                                            |
| Methoxychlor                 | 0.02                                             |
| Metolachlor                  | 0.01                                             |
| Microcystin-LR               | 0.001                                            |
| Melinite                     | 0.006                                            |
| Molybdenum                   | 0.07                                             |
| Mon chloroacetate            | 0.02                                             |
| N-Nitroso dimethylamine      | 0.0001                                           |
| Nickel                       | 0.07                                             |
| Nitrate                      | 50                                               |
| Nitrilotriacetic acid (NTA)  | 0.2                                              |
| Nitrite                      | 3                                                |
| Pendimethalin                | 0.02                                             |
| Pentachlorophenol            | 0.009                                            |
| Permethrin                   | 0.3                                              |
| pH                           | No health-based guideline value is proposed      |
| Pyriproxyfen                 | 0.3                                              |
| Selenium                     | 0.01                                             |
| Simazine                     | 0.002                                            |
| Sulphate                     | No health-based guideline value has been derived |
| Styrene                      | 0.02                                             |
| Terbutylazine                | 0.007                                            |
| Tetrachloroethylene          | 0.04                                             |
| Toluene                      | 0.7                                              |
| Total dissolved solids (TDS) | No health-based guideline value is proposed      |
| Trichloro acetate            | 0.2                                              |
| Trichloroethylene            | 0.02                                             |
| 2,4,6, -Trichlorophenol      | 0.2                                              |
| Trifluralin                  | 0.02                                             |

| Parameters     | Standard limits as per WHO Guidelines (mg/L) |
|----------------|----------------------------------------------|
| Tritium        | 10000 Bq/L                                   |
| Uranium        | 0.015                                        |
| Vinyl chloride | 0.0003                                       |
| Xylenes-total  | 0.5                                          |
| Zinc           | No health-based guideline value is proposed  |

Water contains naturally occurring compounds such as lead and arsenic among others. How harmful are these and what is the level of contamination, we must know about.

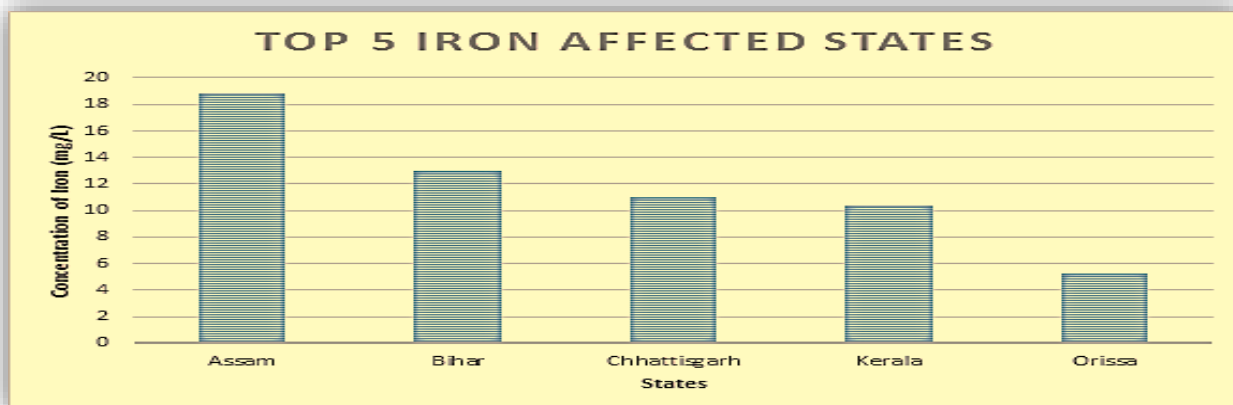
### 2.4.3 Water quality in India Source UNICEF Repository

Both rural and urban India is faced with water problems. People do not have access to good quality, safe drinking water. The source for most drinking water is either rivers or underground aquifers (wells). Since water can dissolve just about anything that it meets long enough, often the groundwater we get isn't pure.

It could contain naturally occurring lead, arsenic, mercury, radium, chloride, iron and copper compounds dissolved in it. Most of these aren't harmful when consumed in small quantities. But when the levels go higher than the prescribed amounts, it could be harmful and sometimes, even fatal. Let's analyze the effects of each of these compounds on our health and understand from the available data which states in India are susceptible to which types of contamination.

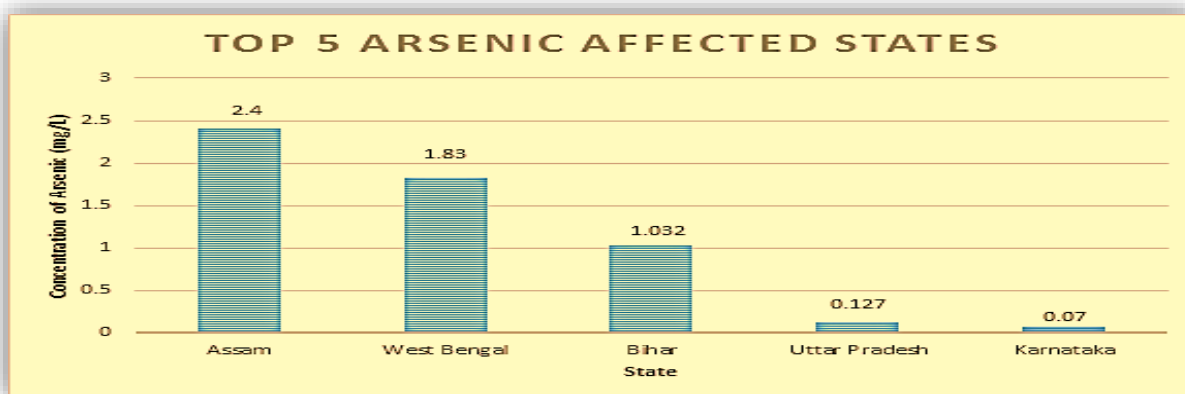
### 2.4.4 Iron

Iron, which is seldom found in concentrations greater than 10 milligrams per liter (mg/L) or 10 parts per million can be a troublesome chemical in drinking water. Corrosion of pipes is a common reason why iron is found in drinking water. As little as 0.3 mg/L concentration of iron can make the water appear brown. A laboratory analysis of the water sample can tell you the extent of your problem.



The best way to treat this is to use aeration/ filtration or chlorination techniques. Chlorination is the process of adding the element chlorine to the water to make it fit for human consumption.

#### 2.4.5 Arsenic



Arsenic is a semi-metal found in various foods and mostly in groundwater. Elevated levels of arsenic lead to metabolism failure in the body causing severe heart diseases, night blindness, cancer and even diabetes. A study conducted by USA today.com states that around 70 countries are affected by arsenic poisoning from groundwater. Assam and West Bengal have high concentrations up to 2.4 mg/L and 1.83 mg/L respectively.

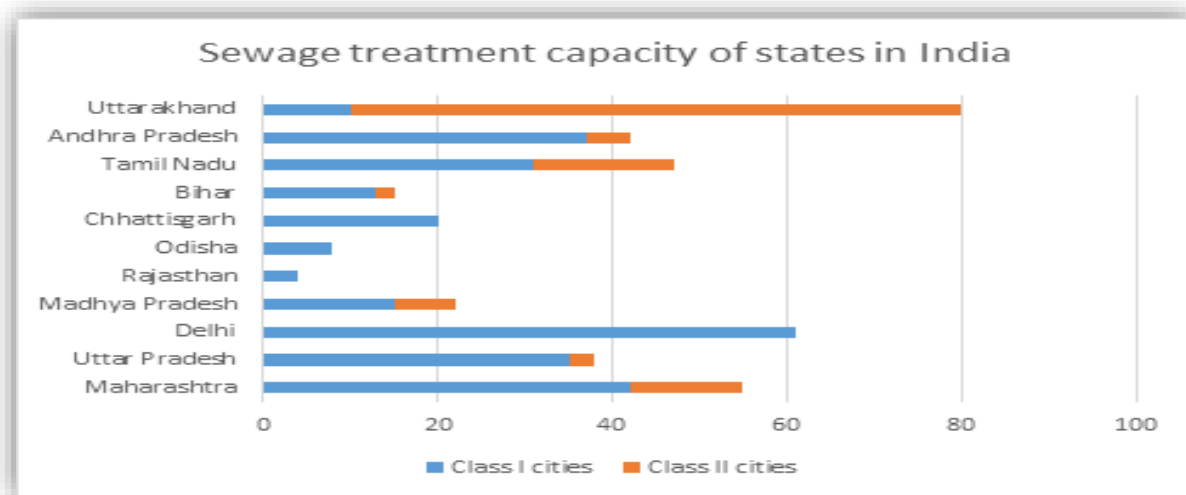
#### 2.4.6 Chlorine and Fluoride

Chlorine and fluoride are added to water to kill pathogens, which are disease producing agents. An excess amount of chlorine in the water causes a problem because it leaves behind a residue. This “residual amount”, when consumed, reacts inside the stomach, and damages some cells of the organs.

Fluoride is added in water just to prevent cavities, whether you have cavities or not! An excess amount of fluoride in water causes tooth discoloration forming yellow or brown pits and patches on teeth. Long term high exposure (more than 4 ppm) to fluoride may also result in bone spurs and birth defects. Rajasthan and Assam have the highest concentrations of these.

### 2.4.7 Nitrate

Nitrate, a naturally occurring form of nitrogen, is found in the soil. It is required in large quantities to sustain high crop yields. A tasteless, colorless, and odorless compound, you cannot detect it unless your water is chemically analyzed. If you drink water from a private well, get a qualified laboratory to test it yearly. Times of India reported, “Dental and spine-related ailments are showing up in many cities and villages of Karnataka due to increasing levels of Nitrate concentration in drinking water.”



## 2.5 Sewage treatment capacity of states in India

The major cause of increasing nitrate content is open sewage disposal and the use of nitrogen fertilizers. Since rural sanitation in the country is poor, the presence of nitrates in water is evident of such contamination. Proper sewage treatment including contaminants and recycling of wastewater to reuse it for various uses like gardening, toilet flushing, and car washing is necessary to keep these levels down. Currently Maharashtra and Uttar Pradesh have the highest sewage treatment capacity in India in Class I cities.

From the above analysis, we can see the extent of contamination that we are exposed to. Here are some safeguards that we can take to get clean drinking water.

- Water supply protection is most effective before contamination occurs. Surface water must never be allowed to flow down in the well. Rainwater and runaway water should be sloped out of a water body. A minimum of 300 feet distance must be maintained between sewage disposal and water supply areas.
- Also, it is important to locate and eliminate the source of the contamination. For example, lead and iron contamination can be eliminated by replacing pipes, fittings, and fixtures.
- New sources for water supply should be developed in case the existing supply is extensively contaminated with nitrate, salt, pesticides, and other chemicals.
- Lastly, water must be treated to remove possible disinfectants and chemicals.

### 2.5.1 INDIAN STANDARDS FOR SAFE DRINKING WATER

- The Bureau of Indian Standards (BIS) has specified drinking water quality standards in India to provide safe drinking water to the people. It is necessary that drinking water sources

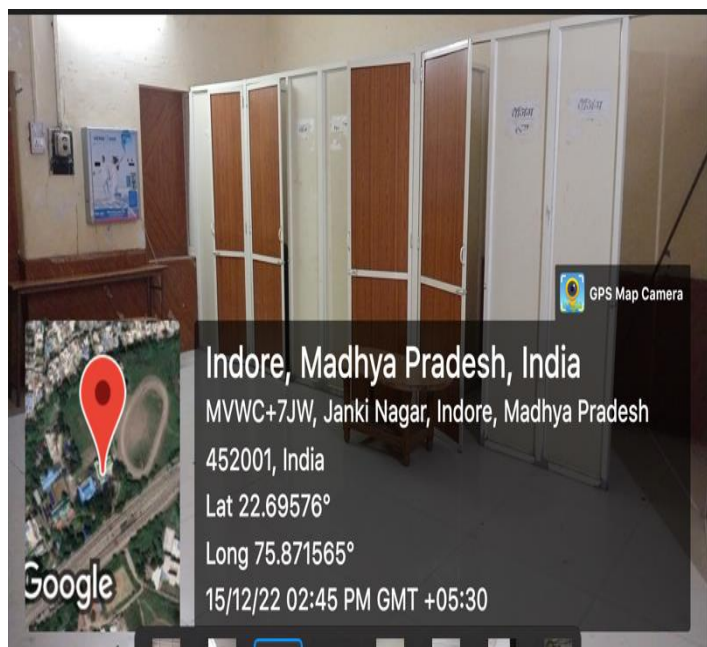
should be tested regularly to know whether water is meeting the prescribed standards for drinking or not and, if not, then, the extent of contamination/ unacceptability and the follow-up required.

- Apart from BIS specification for drinking water, there is one more guideline for water quality, brought out by the Ministry of Water Resources, Government of India in 2005. This is known as Uniform Protocol for Water Quality Monitoring. A need has arisen to have a separate uniform protocol for Drinking Water Quality Monitoring in view of increasing risk of geogenic and anthropogenic contamination.
- Keeping in view requirement of preparing Uniform Drinking Water Quality Monitoring Protocol, the Ministry of Drinking Water and Sanitation (MDWS), Government of India constituted an Expert Group which prepared the Protocol. The Drinking Water Quality Monitoring protocol describes specific requirements for monitoring drinking water quality with a view to ensure provision of safe drinking water to the consumers.

### **2.5.2 Definition of drinking water quality**

**BIS has set specifications in IS–10500 and subsequently the revised edition of IS 10500: 2012 in Uniform Drinking Water Quality Monitoring protocol.**

- Some parameters apart from those mentioned in IS 10500: 2012 may also be measured if the States deem it necessary. This standard has two limits i.e., Acceptable limits and permissible limits in absence of alternate source. If any parameter exceeds the limit, that water is considered unfit for human consumption.
- Broadly speaking water is defined as unfit for drinking as per Bureau of Indian Standards, IS-10500-2012, if it is bacteriologically contaminated (presence of indicator Uniform Drinking Water Quality Monitoring Protocol bacteria particularly E-coli, viruses etc.) or if chemical contamination exceeds maximum permissible limits (e.g. excess fluoride [ $>1.5\text{mg/l}$ ], Total Dissolved Solids (TDS) [ $>2,000\text{ mg/l}$ ], iron [ $>0.3\text{ mg/l}$ ], manganese [ $>0.3\text{ mg/l}$ ], arsenic [ $>0.05\text{mg/l}$ ], nitrates [ $>45\text{ mg/l}$ ] etc.).



Provision of Water Coolers with RO plant & well sanitized Washrooms

Table: I The latest drinking water specification and test protocol are:

| Sr. No. | Test Parameter                                       | IS: 10500-2012<br>Drinking Water Specification<br>(Second Revision) |                                                            | Method of Test<br>(Indian Standard IS:3025<br>Methods of Sampling and<br>Test for Water and Waste<br>Water) |
|---------|------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
|         |                                                      | Requirement<br>(Acceptable limit)                                   | Permissible limit<br>In the Absence of<br>alternate source |                                                                                                             |
| 1.      | Odor                                                 | Agreeable                                                           | Agreeable                                                  | IS:3025 Part 5                                                                                              |
| 2.      | Taste                                                | Agreeable                                                           | Agreeable                                                  | IS:3025 Part 8                                                                                              |
| 3.      | pH value                                             | 6.5 – 8.5                                                           | No relaxation                                              | IS:3025 Part 11                                                                                             |
| 4.      | Turbidity, NTU, Max                                  | 1                                                                   | 5                                                          | IS:3025 Part 10                                                                                             |
| 5.      | Total dissolved solids<br>(TDS), mg/l, Max           | 500                                                                 | 2000                                                       | IS:3025 Part 16                                                                                             |
| 6.      | Total alkalinity as<br>CaCO <sub>3</sub> , mg/l, Max | 200                                                                 | 600                                                        | IS:3025 Part 23                                                                                             |

| Sr. No. | Test Parameter                     | IS: 10500-2012<br>Drinking Water Specification<br>(Second Revision) |                                                            | Method of Test<br>(Indian Standard IS:3025<br>Methods of Sampling and<br>Test for Water and Waste<br>Water) |
|---------|------------------------------------|---------------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
|         |                                    | Requirement<br>(Acceptable limit)                                   | Permissible limit<br>In the Absence of<br>alternate source |                                                                                                             |
| 7.      | Total hardness as CaCO3, mg/l, Max | 200                                                                 | 600                                                        | IS:3025 Part 21                                                                                             |
| 8.      | Calcium as Ca, mg/l, max           | 75                                                                  | 200                                                        | IS:3025 Part 40                                                                                             |
| 9.      | Magnesium as Mg, mg/l, Max         | 30                                                                  | 100                                                        | IS:3025 Part 46                                                                                             |
| 10.     | Chloride as Cl, mg/l, Max          | 250                                                                 | 1000                                                       | IS:3025 Part 32                                                                                             |
| 11.     | Residual Free Chlorine, mg/l, Min* | 0.2                                                                 | 1                                                          | IS:3025 Part 26                                                                                             |
| 12.     | Sulphate as SO4, mg/l, max         | 200                                                                 | 400                                                        | IS:3025 Part 24                                                                                             |
| 13.     | Nitrate Nitrogen as NO3, mg/l, Max | 45                                                                  | No relaxation                                              | IS:3025 Part 34                                                                                             |
| 14.     | Fluoride as F, mg/l, Max           | 1.0                                                                 | 1.5                                                        | IS:3025 Part 60                                                                                             |
| 15.     | Total Iron as Fe, mg/l, Max        | 0.3                                                                 | No relaxation                                              | IS:3025 Part 53                                                                                             |
| 16.     | Coliform MPN/100 ml                | Shall not be detectable in any 100 ml sample                        |                                                            | Indian Standard IS:1622, Methods of Sampling and Microbiological Examination of water.                      |
| 17.     | Fecal Coliform, Presence/Absence   | Shall not be detectable in any 100 ml sample                        |                                                            |                                                                                                             |
| 18.     | E. coli, Presence/Absence          | Shall not be detectable in any 100 ml sample                        |                                                            |                                                                                                             |

\*Applicable only when water is chlorinated

## 2.6 As per Central Ground Water Board report of September 2013:

Table: II General range of Important Chemical Constituents

| Sr.No. | Constituent             | Range |      | ISI Standards Desirable | Permissible |
|--------|-------------------------|-------|------|-------------------------|-------------|
|        |                         | Min   | Max  |                         |             |
| 1      | pH                      | 7.43  | 8.90 | 6.5–8.5                 | No range    |
| 2      | E.C/ $\mu$ S/cm at 25°C | 110   | 3263 | 750                     | 3000        |
| 3      | Total Hardness (mg/l)   | 45    | 660  | 300                     | 600         |
| 4      | Ca(mg/l)                | 8     | 166  | 75                      | 200         |
| 5      | Mg(mg/l)                | 1.0   | 113  | 30                      | 100         |
| 6      | Na(mg/l)                | 5.0   | 506  | -                       | -           |
| 7      | K (mg/l)                | 1.0   | 180  | -                       | -           |
| 8      | Co <sub>3</sub> (mg/l)  | Nil   | 87   | -                       | -           |
| 9      | HCo <sub>3</sub> (mg/l) | 24    | 634  | -                       | -           |
| 10     | Cl(mg/l)                | 7.0   | 695  | 250                     | 1000        |
| 11     | So <sub>4</sub> (mg/l)  | 0.5   | 192  | 200                     | 400         |
| 12     | No <sub>3</sub> (mg/l)  | 0.4   | 249  | 45                      | 100         |
| 13     | F (mg/l)                | 0.04  | 1.6  | 1.0                     | 1.5         |

## Water Quality Samples

### 2.7 Sample Quality of water in terms of pH, TDS, EC. At Holkar Science College

Tube well: Out of total 10 submersibles 3 were identified.

| S. No. | Place from where water sample collected | pH value | Permissible value | TDS | Permissible value | Electrical Conductivity E.C/ $\mu$ S/cm at 25°C | Permissible value |
|--------|-----------------------------------------|----------|-------------------|-----|-------------------|-------------------------------------------------|-------------------|
|        | 1                                       | 2        | 3                 | 4   | 5                 | 6                                               | 7                 |

| S. No. | Place from where water sample collected | pH value | Permissible value                    | TDS | Permissible value                                  | Electrical Conductivity E.C/ $\mu$ S/cm at 25°C | Permissible value                         |
|--------|-----------------------------------------|----------|--------------------------------------|-----|----------------------------------------------------|-------------------------------------------------|-------------------------------------------|
| 1      | Red building bore                       | 6.9      | No relaxation<br><br>IS:3025 Part 11 | 428 | Acceptable Limit<br><br>500<br><br>IS:3025 Part 16 | 635                                             | Up to 750 (desirable) as per IS standards |
| 2      | Sports ground bore                      | 7.2      |                                      | 453 |                                                    | 642                                             |                                           |
| 3      | Academic block bore                     | 7.8      |                                      | 462 |                                                    | 627                                             |                                           |

### 2.7.1 Test for Bacteria presence in water

| S. No | Sample collected from | Process adopted to test for bacteria                                    | Result Presence of Bacteria | Chlorination in ppm IS:3025 Part 26 | Result            |
|-------|-----------------------|-------------------------------------------------------------------------|-----------------------------|-------------------------------------|-------------------|
|       | 8                     | 9                                                                       |                             | 10                                  | 11                |
| 1     | Red building bore     | It was tested through Site sample kit provided by Prerenal Laboratories | Negative                    | 0.3                                 | Safe for drinking |
| 2     | Sports ground bore    |                                                                         | Negative                    | 0.2                                 | Safe for drinking |
| 3     | Academic block bore   |                                                                         | Negative                    | 0.3                                 | Safe for drinking |

### 2.7.2 Test for Copper, Sulphates and Fluorides

| S. No. | Sample | Hardness testing ppm | Copper ppm | Fluoride as F, mg/l, Max | Permissible limit mg/l, | Presence of Sulphates Mg/l | Permissible Limit Mg/L |
|--------|--------|----------------------|------------|--------------------------|-------------------------|----------------------------|------------------------|
|        | 12     | 13                   | 14         | 15                       | 17                      | 18                         |                        |

| S. No. | Sample              | Hardness testing ppm | Copper ppm    | Fluoride as F, mg/l, Max | Permissible limit mg/l,         | Presence of Sulphates Mg/l | Permissible Limit Mg/L |
|--------|---------------------|----------------------|---------------|--------------------------|---------------------------------|----------------------------|------------------------|
| 1      | Red building bore   | 100                  | Less than 0.2 | 0.65                     | 1.0 mg/l<br><br>IS:3025 Part 60 | 159                        | 200 Acceptable limits  |
| 2      | Sports ground bore  | 100                  | Less than 0.2 | 0.68                     |                                 | 128                        | IS:3025 Part 24        |
| 3      | Academic block bore | 100                  | Less than 0.2 | 0.00                     |                                 | 150                        |                        |

Total 18 parameters of water were tested in field test. All the results were within permissible limits of Indian Standards

## 2.8 Ground water

Indore is however safe for drinking as per the Ground water report as above but it is recommended to send samples to State Pollution Control Board approved Laboratory for testing.

### 2.8.1 Groundwater Quality

#### A. Color

Color is measured in Platinum Cobalt Scale. The color obtained in all the groundwater samples GW-1 to GW-18 is 1 or less than 1.

#### B. pH

The pH value ranges between 6.9 and 8.3. The lowest value is observed in GW-14 i.e 6.9 whereas higher pH values were observed in samples GW-2, all the groundwater samples showed good pH range or values. It is also observed that all the water samples lie in the range of 6.5 – 8.5 prescribed by Indian Standards for Drinking Water.

#### C. Turbidity

Turbidity is measured in the Nephelometric Turbidity Unit (NTU). The turbidity for nearly all the samples remained less than 1 NTU except for sample GW-10 and GW-15, the turbidity lies in the range 2 – 4.5 NTU. The reason for the high values may be due to organic contaminants coming into the well.

#### D. Electrical Conductivity

Electrical conductivity (EC) is a useful tool to evaluate the purity of water. Maximum EC is recorded in GW-4 (1843.4  $\mu$  mhos/cm) and the minimum EC at GW-11 (734  $\mu$  mhos /cm). In general, the EC for maximum samples is above 1200  $\mu$  mhos/cm.

## 2.9 Total Dissolved Solids

The Total Dissolved Solids (TDS) of the water samples ranged from 425 mg/L to 1350 mg/L. TDS value of 425 mg/l is shown by sample GW-11, whereas GW-4 showed a value of 1350 mg/l. Whereas TDS of RO water ranged between 55 to 100 mg/l.

## 2.10 Quality of ground water for drinking

Ground water quality in Indore district is assessed annually by CGWB on the basis of water samples collected from hydrograph stations in the district. Ground water in the district is generally medium to high saline as electric conductivity values vary between 586 to 3780  $\mu$ s/cm. Nitrate in the ground water of Indore district is varying between 0.5 to 296 mg/l. Nitrate more than 45 mg/l was found in four villages namely Sanwer (52 mg/l), Hatod (79 mg/l), Machal (139 mg/l) and Ushapura (177 mg/l). High nitrate in the village area is apparently due to excessive use of fertilizers and agricultural waste. The total hardness of groundwater in the district is generally under safe limit as per BIS standards. Ground water of Machal, Sanwer and Ushapur village is not safe for drinking. Fluoride in the district is in the range of 0.12 to 0.48 mg/l, i.e., well below 1.5 mg/l. No arsenic has been detected in the district.

## 2.11 Quality of water for irrigation

High SAR is not good for irrigation as it leads to sodium hazard. Water samples in the district generally fall in C2 S1, C3 S1 and C4 S1 classes of US salinity diagrams. However, ground water in the district is generally safe for irrigation but a proper drainage system is required where EC is more than 1500  $\mu$ s/cm.

According to International Journal of preventive medicine research Potential Health Impacts of Hard Water PMID: PMC3775162 PMID: 24049611, Int J Prev. Med. 2013 Aug; 4(8): 866–875.

### 2.11.1.1 pH value:

A pH of 7 is considered neutral. That “seven” number is considered neutral or balanced between acidic and alkaline. **If water is below 7 on the pH scale, it's "acidic." If it's higher than 7, it's "alkaline."** EPA guidelines state that the pH of tap water should be between 6.5 and 8.5.

Acidic water with a pH of less than 6.5 is more likely to be contaminated with pollutants, making it unsafe to drink. It can also corrode (dissolve) metal pipes.

Many municipal water suppliers voluntarily test the pH of their water to monitor for pollutants, which may be indicated by a changing pH. When pollutants are present, water companies treat their water to make it safe to drink again.

### 2.11.1.2 Alkaline water

Alkaline water has become a popular drinking water choice over the past few years. Some people say that drinking slightly alkaline water — with a pH between 8 and 9 — can improve your health. They say it may make you age more slowly, maintain a healthy pH in your body, and block chronic disease like cancer.

### 2.11.1.3 Electrical Conductivity of Water

Pure water is not a good conductor of electricity. Ordinary distilled water in equilibrium with carbon dioxide of the air has a conductivity of about  $10 \times 10^{-6} \text{ W}^{-1}\cdot\text{m}^{-1}$  (20 dS/m). Because the electrical current is transported by the ions in solution, the conductivity increases as the concentration of ions increases.

Electrical conductivity (EC) is a **measurement of water's ability to conduct electricity**. EC is related to water temperature and the total concentration, mobility, valence and relative concentration of ions. Higher EC means more electrolytes in the water.

The reason that the conductivity of water is important is because **it can tell you how much dissolved substances, chemicals, and minerals are present in the water**. Higher amounts of these impurities will lead to a higher conductivity.

| Types of water                     | Conductivity Value                   |
|------------------------------------|--------------------------------------|
| Pure distilled and Deionized water | 0.05 $\mu\text{S}/\text{cm}$         |
| Seawater                           | 50 mS/cm                             |
| Drinking water                     | 200 to 800 $\mu\text{S}/\text{cm}$ . |
| Rain or Snow water                 | 2 to 100 $\mu\text{S}/\text{cm}$     |

$\mu\text{S}/\text{cm}$  means **micro-Siemens per centimeter**, a measure of electrical conductivity; it is equal to  $\mu\text{mhos}/\text{cm}$ ; BASIS FOR CHANGE: The Department proposes to add this definition, which is the measure of conductivity in the International System of units, and to substitute it for  $\mu\text{mhos}/\text{cm}$  throughout the Standards. **1 PPM is equal to 1.56 micro-S/cm**.

### 2.11.1.4 Sulphates in drinking water

People who are not used to drinking water with high sulfate can get diarrhea and dehydration from drinking the water. Infants are often more sensitive to sulfate than adults. To be safe, only use water with a sulfate level lower than 500 milligrams per liter (mg/L) to make infant formula. Older children and adults may get used to high sulfate levels after a few days.

### 2.11.1.5 Presence of Copper in water

How to Protect Yourself and Your Family Drinking water with more than 1,300 micrograms of copper per liter of water ( $\mu\text{g}/\text{L}$ ) can be a health risk for everyone. Infants and people with Wilson's

disease may need water with an even lower level of copper to stay safe. Copper can get into your drinking water as it passes through your plumbing system. Over time, plumbing parts with copper in them usually build up a natural coating that prevents copper from being dissolved into the water. Plumbing systems with copper parts fewer than three years old usually have not had time to build up this protective coating.

#### *2.11.1.6 Presence of Fluorides in drinking water*

Fluoride prevents tooth decay by making teeth stronger and more resistant to acid attacks. It also helps with slowing down or stopping the decay process. When fluoride levels in water are at optimal levels, it helps to protect teeth against cavities. Excess amounts of fluoride ions in drinking water can cause dental fluorosis, skeletal fluorosis, arthritis, bone damage, osteoporosis, muscular damage, fatigue, joint-related problems, and chronicle issues.

### *3.0 Water Quantity*

#### *3.1 According to the report*

According to STATE ENVIRONMETAL PLAN Madhya Pradesh Department of Environment Government of Madhya Pradesh, December, 2021 plan published, the average rainfall received by the State is around 1024.3 mm. Madhya Pradesh has five major river Basins namely Ganga (Yamuna Basin), Narmada Basin, Tapti Basin, Mahi Basin and Wainganga (part of Godawri Basin). These basins are divided into 12 sub basins and further sub divided into 155 major watersheds out of which 6 watersheds in Son and Narmada sub-basin falls partly in adjoining Chhattisgarh State.

The main source of recharge to the basaltic aquifer in the district is rainfall. To some extent, recharge also takes place by influent seepage from the streams and their tributaries. Due to low permeabilities of basalts and undulating topography, the runoff is very high. This restricts the recharge to groundwater body. This is the reason for large scale seasonal fluctuation in the water level of the wells tapping trappean formation. Groundwater in the Deccan Traps in Indore district occurs mostly under water table conditions. The nature of topography, extent and depth of weathering, distribution of secondary porosity in the form of fractures and joints and the occurrence and disposition of vesicular units govern the movement of groundwater. At some places, confined conditions area also observed due to the alternating nature of the impermeable massive and productive vesicular basalts. At places, like Khajarana, Betwa and Gautampura, semi-artesian conditions are also observed.

The Central Ground Water Board has drilled 9 exploratory wells, 14 observation wells and 37 piezometers in the district. These boreholes drilled down to a depth of 100 mbg. Older Trap have recorded higher yields – 375 to 825 lpm as compared to boreholes piercing younger trappean units in the southern part of the district where the yields vary between 75 to 225 lpm. It has also been observed that the yields of dug-cum-bore wells tapping confined aquifers are two to three times higher than the yields of wells tapping the water table aquifer.

In 2019, ground water level for Indore District was 3.59 meters below ground level. Ground water level of Indore District fell gradually from 13.68 meters below ground level in 2015 to 3.59 meters below ground level in 2019.

#### *3.2 Methodology for reduction in water consumption*

Here are a few methods that can reduce the usage of water inside buildings:

- Rainwater Harvesting. Rainwater Harvesting is a method that can be quite easily implemented.
- Water Metering
- Pressure reducing valves
- Water-saving showerheads
- Greywater Recycling system
- Smart irrigation systems
- Water-efficient toilets
- Float valves on the tanks above the quarters/ homes and buildings

### **3.3** *Broadly speaking, you can reduce your direct water footprint by*

- Turning off the tap while brushing your teeth.
- Using water-saving toilets.
- Installing a water-saving shower head.
- Taking shorter showers.
- Only wash clothes when necessary.
- Fixing household leaks.
- Using less water in the garden and when cleaning. Preferably use recycled water.
- Adopting drip irrigation methods.

### **3.4** *Measure daily consumption data*

As per Central Ground Water Authority As a general rule the following rates per capita per day may be considered for domestic and nondomestic needs: a) For communities with populations up to 20,000: b) For communities with : 100 to 135 lphd population 20,000 to 100,00 together with full flushing system c) For communities with population: 150 to 200 lphd above 100,000 together with full flushing system Note—The value of water supply given as 150 to 200 liter per head per day may be reduced to 135 liter per head per day for houses for Medium Income Group (MIG) and Low Income Groups (LIG) and Economically Weaker Section of Society (EWS), depending upon prevailing conditions and availability of water. Out of the 150 to 200 liters per head per day, 45 liters per head per day may be taken for flushing requirements and the remaining quantity for other domestic purposes.

## Water Audit Process

Measurement



### **3.5**    *Measure the pumping hours*

The best way to control the water is to measure daily water demand which is being extracted from the source. For this we can use Water Meter and Energy meter. Water meter is for water consumption and the Energy meter is to check the energy consumed. Check it daily. Find out the leakages and ultimately check where water consumption is more. At each overhead tank we

should provide a float valve so that unnecessary waste of water and energy shall be reduced. See the possibility if water consumption can be reduced. A periodical analysis will reduce the water and energy consumption to an optimum level.

- Recharging of ground water through RWH
- Observe the Ground water table before and after monsoon.
- Please observe the groundwater recharge position (Level whether increase or decrease). This will give an extra credit for achieving the ground water recharge to the College.
- Participation of student groups should be made to further increase their awareness towards water conservation.

### 3.6 College water resources

The major resource for the water in the college is a self-reliant water boring system installed on the campus. There are 10 numbers of tube-well installed of different capacity motors, although the measurement has never been done. Water being taken from the municipal corporation, but the records were not produced by the authority. Audit team has just taken assumption of possible drawdown from ground water and through the municipal water supply.

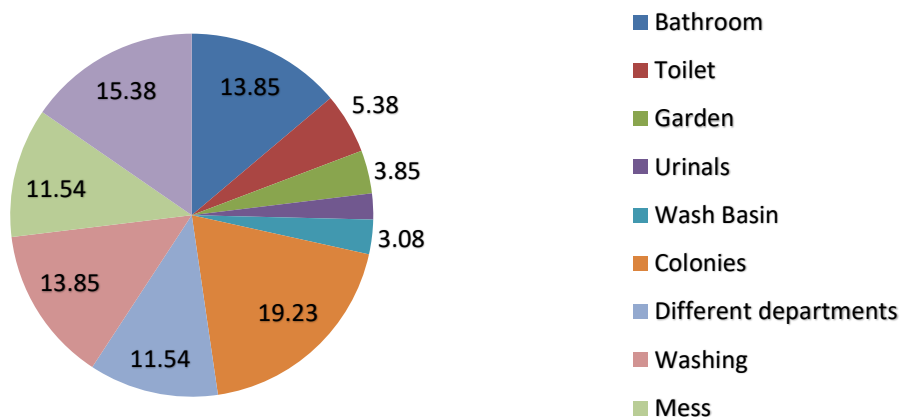
### 3.7 Water consumption in the College

From the data collected for the water audit of Holkar Science College, the water distribution and water consumption pattern are noticed as follows for daily consumption of 30kL of water.

Yearly Average Water Consumption at Holkar Science College

| S. No.       | Sector                  | Total Daily Use (KL) | Total Monthly Use (KL) | Total Yearly use (KL) | Percentage (%) |
|--------------|-------------------------|----------------------|------------------------|-----------------------|----------------|
| 1            | Bathroom                | 4.155                | 124.65                 | 1495.8                | 13.85          |
| 2            | Toilet                  | 1.614                | 48.42                  | 581.04                | 5.38           |
| 3            | Garden                  | 1.155                | 34.65                  | 415.8                 | 3.85           |
| 4            | Urinals                 | 0.924                | 27.72                  | 332.64                | 3.08           |
| 5            | Wash Basin              | 0.69                 | 20.7                   | 248.4                 | 2.3            |
| 6            | Colonies                | 5.769                | 173.07                 | 2076.84               | 19.23          |
| 7            | Different departments   | 3.462                | 103.86                 | 1246.32               | 11.54          |
| 8            | Washings                | 4.155                | 124.65                 | 1495.8                | 13.85          |
| 9            | Mess                    | 3.462                | 103.86                 | 1246.32               | 11.54          |
| 10           | Water loss at discharge | 4.614                | 138.42                 | 1661.04               | 15.38          |
| <b>Total</b> |                         | <b>30</b>            | <b>900</b>             | <b>10800</b>          | <b>100</b>     |

## Uses of Water Percentage as per assumption



**MP Industrial Development Corporation Ltd.**  
(Government of Madhya Pradesh Undertaking)



| S.No | AKVN   | Water Charges                                                                                                                           |
|------|--------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Indore | 1. Rs 41.88 per KL for industrial areas<br>2. Rs 49.93 per KL for units outside industrial areas<br>3. Rs 29.00 per KL for local bodies |

|    |                                                                             |     |
|----|-----------------------------------------------------------------------------|-----|
| 5. | Fruit Crops:-<br>Bananas, Beetel, Garden crops, Rubber<br>plants, Sugarcane | 960 |
| 6. | Barseem grass (fodder crop)                                                 | 480 |

## 2. Water rate for drinking and domestic use.-

| S.No. | Description                                                                                                                                                                                         | Water rate                                                                                                                                          |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| (1)   | Water supply to Municipal Corporation/Municipality/Nagar Panchayat/Gram Panchayat/Public Health Engineering Department for domestic use and drinking purposes from natural source/self-made source. | 50% of the water rate applicable as per the notification No. 29/31/99/M/31/83 Bhopal dated 14, January, 2000 with an increase of 1 paise per annum. |

## Gazette Notification of Madhya Pradesh Government.

### Yearly Average Water Consumption at Holkar Science College

The Figure shows the total percentage of water consumed by all the Building Blocks of Holkar Science College, Indore. The figure shows that toilets, washbasins, and bathrooms as the major sources of water utilization comprising 27.40%, 23.04%, and 19.68% respectively. The other uses namely garden, urinals, laboratory, and shower consume water with yearly water requirements of 8.73%, 6.71%, 6.38%, and 5.15% respectively. Further also includes water required for drinking purposes, and loss of water during filling and during discharge which is 2.84%, 0.05%, and 0.02%. It was observed that the water required for drinking purposes is 2.84%. In the case of filling, loss of water was observed 0.05% and during discharging water, the loss is about 0.02% only.

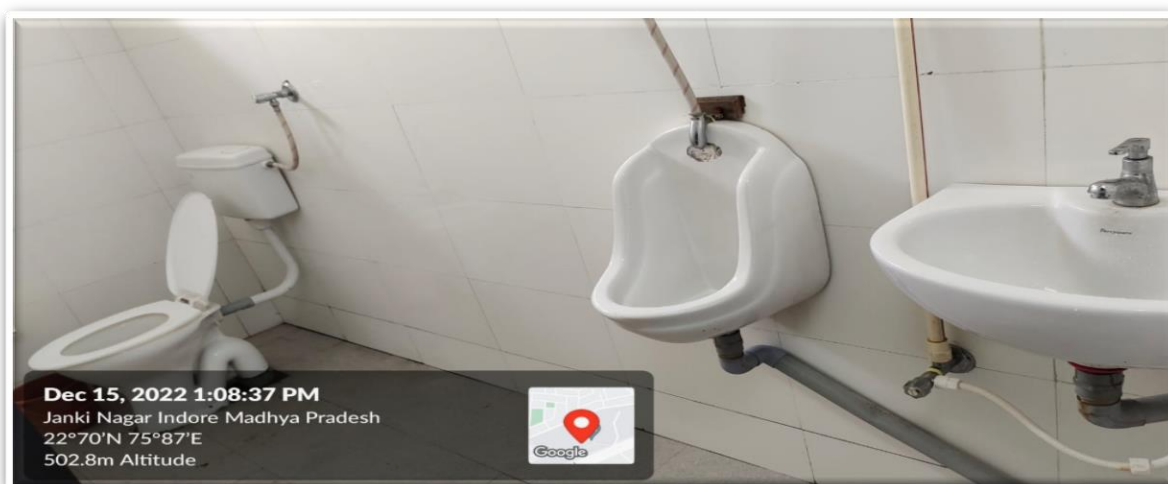
### DETAILS OF TOILETS

| S. No. | Location         | No. of Toilets for Boys | No. of Toilets for Girls | No. of Toilets for Faculties | No. of Toilets for Staffs | Common or Separate |
|--------|------------------|-------------------------|--------------------------|------------------------------|---------------------------|--------------------|
| 1      | Principal office | 00                      | 00                       | 01                           | 01                        | Separate           |
| 2      | Red Building     | 04                      | 10                       | 04                           | 04                        | Separate           |
| 3      | Yashwant Hall    | 01                      | 00                       | 01                           | 00                        | Common             |
| 4      | Chemistry Dept.  |                         | 00                       |                              | 01                        | Common             |
| 5      | Physics Dept.    |                         | 00                       |                              | 01                        | Common             |

| S. No. | Location                 | No. of Toilets for Boys | No. of Toilets for Girls | No. of Toilets for Faculties | No. of Toilets for Staffs | Common or Separate |
|--------|--------------------------|-------------------------|--------------------------|------------------------------|---------------------------|--------------------|
| 6      | Zoology                  | 01                      | 01                       | 00                           | 01                        | Common             |
| 7      | Statistics               | 00                      | 00                       | 00                           |                           | Common             |
| 8      | Botany                   | 00                      | 00                       | 00                           |                           | Common             |
| 9      | Seed                     | 00                      | 00                       | 00                           |                           | Common             |
| 10     | Horticulture             | 00                      | 00                       | 00                           |                           | Common             |
| 11     | Mathematics              | 00                      | 00                       | 00                           | 01                        | Common             |
| 12     | Sports                   | 00                      | 00                       | 00                           |                           | Common             |
| 13     | Electronics              | 00                      | 00                       | 00                           |                           | Common             |
| 14     | Pharmaceutical Chemistry | 00                      | 00                       | 00                           |                           | Common             |
| 15     | Library                  | 04                      | 04                       | 01                           | 01                        | Separate           |
| 16     | Old Academic             | 08                      | 08                       | 01                           | 01                        | Separate           |
| 17     | New Academic             | 04                      | 04                       | 01                           | 01                        | Separate           |
| 18     | Computer Science         | 08                      | 08                       | 02                           | 02                        | Separate           |
| 19     | biochemistry             | 00                      | 00                       | 00                           | 01                        | Common             |
| 20     | New Physics Lab          | 12                      | 12                       | 03                           | 03                        | Separate           |
| 21     | Forensic                 | 00                      | 00                       | 00                           | 01                        | Common             |
| 22     | Language                 | 00                      | 00                       | 00                           | 01                        | Common             |
|        | <b>TOTAL</b>             | <b>42</b>               | <b>47</b>                | <b>14</b>                    | <b>20</b>                 |                    |



Drinking water facility at Holkar Science College



Cleanness of toilets at Holkar Science College.

### 3.8 Sustainable Water Practices

#### 3.8.1 Watershed Management Practices

Holkar Science College has taken many initiatives in water conservation and management of water available on the campus. Now, the College is self-reliant through decentralized water conservation and management practices.

#### 3.8.2 Wastewater Filtration Tank

The College has a huge campus with its administrative setup and there is a lot of wastewaters collected from different areas and other open areas which are disposed of in the tank. College is required to construct a Mini Water Filtration Tank/ recycling on the campus. This filter house is used to filter the wastewater regularly. This water is utilized for further trees and plants in the College campus as self-filtered water throughout the year.

### 3.8.3 Rainwater Harvesting Units

The underground water table is decreasing day by day & minute by minute. There is no attempt to replenish the groundwater table with rainwater during the monsoon & other rainy days. Rainwater harvesting is the simple collection or storing of water through scientific techniques from the areas where the rain falls. It involves the utilization of rainwater for domestic or agricultural purposes. The method of rainwater harvesting has been in practice since ancient times. It is as far from the best possible way to conserve water and awaken society towards the importance of water. The method is simple and cost-effective too. It is especially beneficial in the areas, which face the capacity of water. We can see that the People usually make complaints about the lack of water. During the monsoons, lots of water goes waste into the gutters. And this is when Rainwater Harvesting proves to be the most effective way to conserve water. We can collect the rainwater into the tanks and prevent it from flowing into drains and being wasted. It is practiced on a large scale in metropolitan cities. Rainwater harvesting comprises the storage of water and water recharging through the technical process.

- Non-teaching staff or peons in the concerned section should take responsibility for monitoring the overflow of water tanks.
- A Large amount of water is wasted during the practical process in science laboratories. Designs of small water recycling systems help to reuse water.
- Producing distilled water in the laboratories required a large amount of water to the distillate. To reduce 1 liter of distilled water required more than 33 liters of water. To avoid more wastage, the College should design a common distillation plant for the Science Department.
- Reduce chemical waste formation in the Chemistry laboratory; adopt the principles of green chemistry to reduce chemical waste.
- Pipes, overhead tanks, and plumbing systems should be maintained properly to reduce leakages and wastages of water.
- College should install its own Sewage Treatment Plant (STP). By doing so there will be a great reduction in water usage, as the water after treatment can be used for various purposes in the College.
- As College is already having multiple units of Rainwater Harvesting Units. It will certainly add value to meet the mission of water conservation. And help in increasing the ground water table.

Sub Division Laboratory  
Public Health Engineering Department MHOW

**ANALYSIS REPORT**

Type of Sample: RO Water

Particulars of Sender: प्रो. रा. र. भगत (संस्कृत, ज्योतिष) मेमोरियल विद्यापीठ, नागरीक, इंदौर

Particulars of Sample: Collected / Not Collected by PHED

Sample No. 9 Place of collection and details of sample संस्कृत विद्यापीठ Date 03.01.2023

Sample No. 10 विद्यापीठीय डिस्पेंसरी Date 03.01.2023

Particulars to be filled in the Laboratory

Date of Receipt: 03.01.2023 Time of Receipt: 11:30 AM

Lab. Reference No. - Tested on 03.01.2023

**NATURE OF STUDY - CHEMICAL & BACTERIOLOGICAL ANALYSIS**

| Sl. No. | Characteristics                      | Unit | As Per BIS-10500-2012 For Drinking Water |                                                     | Results  |          |          |          |
|---------|--------------------------------------|------|------------------------------------------|-----------------------------------------------------|----------|----------|----------|----------|
|         |                                      |      | Requirement (Desirable Unit)             | Permissible Unit in the absence of Alternate Source | Sample 1 | Sample 2 | Sample 3 | Sample 4 |
| 14      | Sulphate as SO <sub>4</sub>          | Mg/l | 200                                      | 400                                                 | 50       | 54       |          |          |
| 15      | Fluoride as F                        | Mg/l | 1.0                                      | 3.5                                                 | 0.1      | 0        |          |          |
| 16      | Manganese as Mn                      | Mg/l | 0.1                                      | 0.3                                                 | -        | -        |          |          |
| 17      | Residual Chlorine as Cl <sub>2</sub> | Mg/l | 0.2                                      | 1.0                                                 | -        | -        |          |          |

**BACTERIOLOGICAL TESTS**

| Sl. No. | Characteristics   | Unit       | Requirement (Desirable Unit) | Results |
|---------|-------------------|------------|------------------------------|---------|
| 18      | M. PN of Coliform | Per 100 ml | Nil                          | Nil     |
| 19      | Faecal Coliform   | Per 100 ml | Nil                          | Nil     |

NOTE: The figures indicated under the indicated under the column requirement (Desirable Limit) "the limits upto which water is generally acceptable to the consumers figures in excess of those mentioned under "Requirement (Desirable Limit)" the water not acceptable, but still may be tolerated in the absence of an alternative and better source but upto the limits indicated column "Permissible Limit in the absence of Alternate Source" above which the source will have to be rejected (Guideline values for Drinking Water as per BIS 10500)

In All water intended for drinking, E. Coli or thermo tolerant Coliform bacteria must not be detectable in any 100-ml sample. Total water originating in a distribution system, E. Coli or thermo tolerant coliform bacteria and Total Coliform bacteria must not be detectable in any 100 ml sample. In case of large supplies, when surface samples are examined, must not be present in 95% of sample taken through out any 12 months period.

"अपेक्षित जल नमूनों में परीक्षण किए गए बैक्टीरिया का मान स्वीकार्य सीमा में है।"

Signature of Analyst: S. Sankar

Remarks if any

Sub Division Laboratory  
Public Health Engineering Department  
MHOW

Sub Division Laboratory  
Public Health Engineering Department MHOW

**ANALYSIS REPORT**

Type of Sample: RO Water

Particulars of Sender: प्रो. रा. र. भगत (संस्कृत, ज्योतिष) मेमोरियल विद्यापीठ, नागरीक, इंदौर

Particulars of Sample: Collected / Not Collected by PHED

Sample No. 9 Place of collection and details of sample संस्कृत विद्यापीठ Date 03.01.2023

Sample No. 10 विद्यापीठीय डिस्पेंसरी Date 03.01.2023

Particulars to be filled in the Laboratory

Date of Receipt: 03.01.2023 Time of Receipt: 11:30 AM

Lab. Reference No. - Tested on 03.01.2023

**NATURE OF STUDY - CHEMICAL & BACTERIOLOGICAL ANALYSIS**

| Sl. No. | Characteristics                      | Unit | As Per BIS-10500-2012 For Drinking Water |                                                     | Results  |          |          |          |
|---------|--------------------------------------|------|------------------------------------------|-----------------------------------------------------|----------|----------|----------|----------|
|         |                                      |      | Requirement (Desirable Unit)             | Permissible Unit in the absence of Alternate Source | Sample 1 | Sample 2 | Sample 3 | Sample 4 |
| 14      | Sulphate as SO <sub>4</sub>          | Mg/l | 200                                      | 400                                                 | 50       | 54       |          |          |
| 15      | Fluoride as F                        | Mg/l | 1.0                                      | 3.5                                                 | 0.1      | 0        |          |          |
| 16      | Manganese as Mn                      | Mg/l | 0.1                                      | 0.3                                                 | -        | -        |          |          |
| 17      | Residual Chlorine as Cl <sub>2</sub> | Mg/l | 0.2                                      | 1.0                                                 | -        | -        |          |          |

**BACTERIOLOGICAL TESTS**

| Sl. No. | Characteristics   | Unit       | Requirement (Desirable Unit) | Results |
|---------|-------------------|------------|------------------------------|---------|
| 18      | M. PN of Coliform | Per 100 ml | Nil                          | Nil     |
| 19      | Faecal Coliform   | Per 100 ml | Nil                          | Nil     |

NOTE: The figures indicated under the indicated under the column requirement (Desirable Limit) "the limits upto which water is generally acceptable to the consumers figures in excess of those mentioned under "Requirement (Desirable Limit)" the water not acceptable, but still may be tolerated in the absence of an alternative and better source but upto the limits indicated column "Permissible Limit in the absence of Alternate Source" above which the source will have to be rejected (Guideline values for Drinking Water as per BIS 10500)

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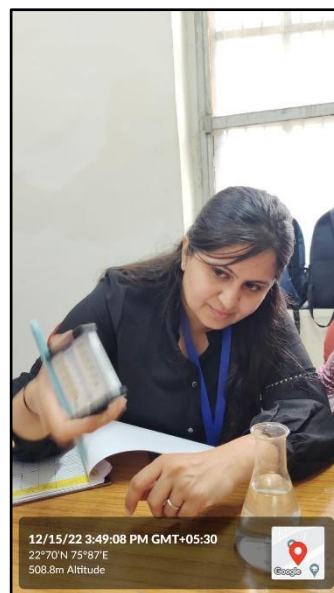
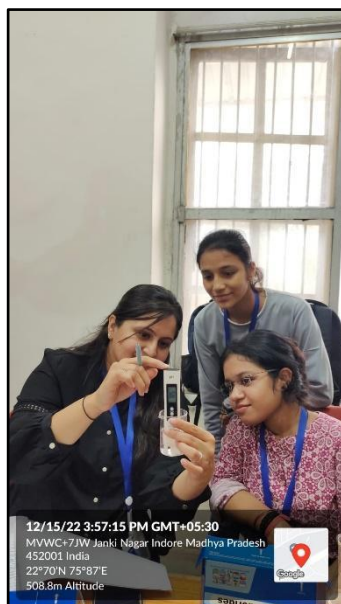
Signature of Analyst: S. Sankar

Remarks if any

Sub Division Laboratory  
Public Health Engineering Department  
MHOW

Water Report received from Public Health Engineering Department MHOW on water Audit also confirmed that the water being used at College is safe

### 3.9 Field Test of Quality of water



Field test being carried out at Holkar Science College on water samples.

### 3.10 Field Test of Quality of water (Copper, Fluoridos, TDS, Hardness)



Field test being carried out at Holkar Science College on water samples.

## 4.0 Air Quality Audit

### 4.1 National Ambient Air Quality Program (NAAQM)

Central Pollution Control Board, New Delhi initiated National Ambient Air Quality Monitoring program in the year 1984 to get a spatial and temporal variation of ambient air concentrations for a wide range of pollutants that are considered relevant for evolving strategic management plan. The program was subsequently renamed NAMP (National Air Quality Monitoring Program). Under NAMP, three air pollutants viz Sulphur dioxide ( $\text{SO}_2$ ), Nitrogen dioxides ( $\text{NO}_2$ ), and Repairable Suspended Particulate Matter (RSPM/PM<sub>10</sub>) have been identified for regular monitoring at three locations. Monitoring of pollutants has been carried out for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) as per CPCB monitoring protocol. One Repairable Dust Sampler (RDS) machine is installed at the Main Gate of the College Campus which monitors the changes in ambient air quality during 24- hours. Holkar Science College monitors air pollution regularly under National Ambient Air Quality Monitoring Program, Central Pollution Control Board, New Delhi.

The objectives of air quality standards are:

- To indicate the levels of air quality necessary with an adequate margin of safety to protect the public.
- health, vegetation, and property.
- To assist in establishing priorities for abatement and control of pollutant level.
- To provide uniform yardstick for assessing air quality at national level.
- To indicate the need and extent of the monitoring programs.

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| City                 | Indore                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| State                | Madhya Pradesh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Location             | 22 o 26'24" N and 75o 30'E, elevation of 550 meter above sea level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Area                 | 130 km <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Population           | 16,39,044                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Climate              | <p>Tropical wet and dry climate and a humid subtropical climate. Three distinct seasons are observed: summer, monsoon and winter. Summers start in mid-March and can be extremely hot in April and May. Due to Indore's location on the southern edge of the Malwa Plateau, a cool breeze in the evenings makes summer nights quite pleasant.</p> <p>Temperature: Average Summer temperatures may go as high as 42-44.c (100.4 °F) but humidity is very low. The monsoon season starts in late June, with temperatures averaging around 26 °C (79 °F), with sustained, torrential rainfall and high humidity. Winters start in mid-November and are dry, mild and sunny. Temperatures average about 4–15 °C (39–59 °F) but can fall close to freezing on some nights.</p> <p>Rainfall: Average rainfall of Indore district is about 980 mm</p> |
| Geography            | Located in the southern edge of the Malwa plateau, on the Saraswati and Khan rivers, which are tributaries of the Shipra River. Isolated patches of alluvium also occur along the Kshipra and Khan rivers and the Katkiya nalla                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Industries           | Food product, Tobacco product, Cotton textile, Wool milk, synthetic powder, Jute product, Hosiery garments, Wood products, Paper and paper product, Leather and leather product, Rubber and Plastic products, Chemical and chemical product, Metal product, Basic metal industries, Machinery parts, Electric machinery product, Repairing and servicing, Steel furniture, Printing, Paints & Varnish, Pulses mills, Cold storage and Fertilizers, Electronics & Computer parts, Readymade garments, etc. The total number of registered units (small scale and cottage) in the city is 10247 (up to March 2002).                                                                                                                                                                                                                              |
| Air Quality Stations | 3 (2 residential, 1 industrial)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Air Quality Trend    | Analysis of nine-year air quality data with respect to PM <sub>10</sub> shows a decreasing trend till 2007 and increasing thereafter till 2009. NO <sub>2</sub> and SO <sub>2</sub> showed a stable trend. (Figure 7.34).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

Figure 1. Source: CPCB: NATIONAL AMBIENT AIR QUALITY STATUS & TRENDS IN INDIA-2010

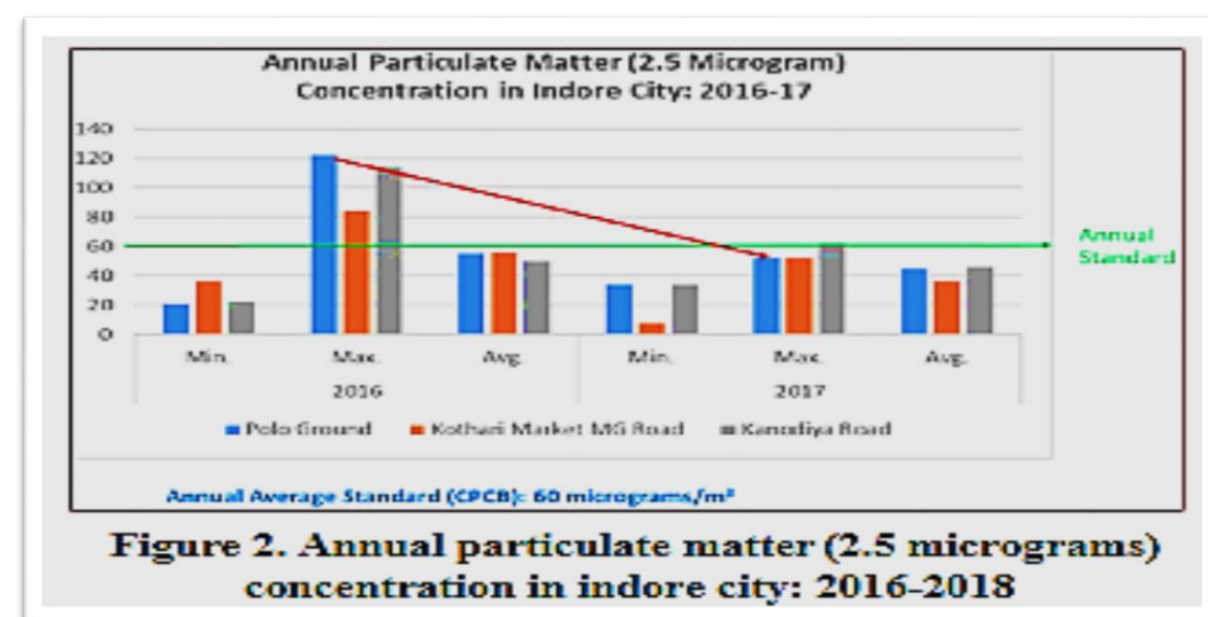
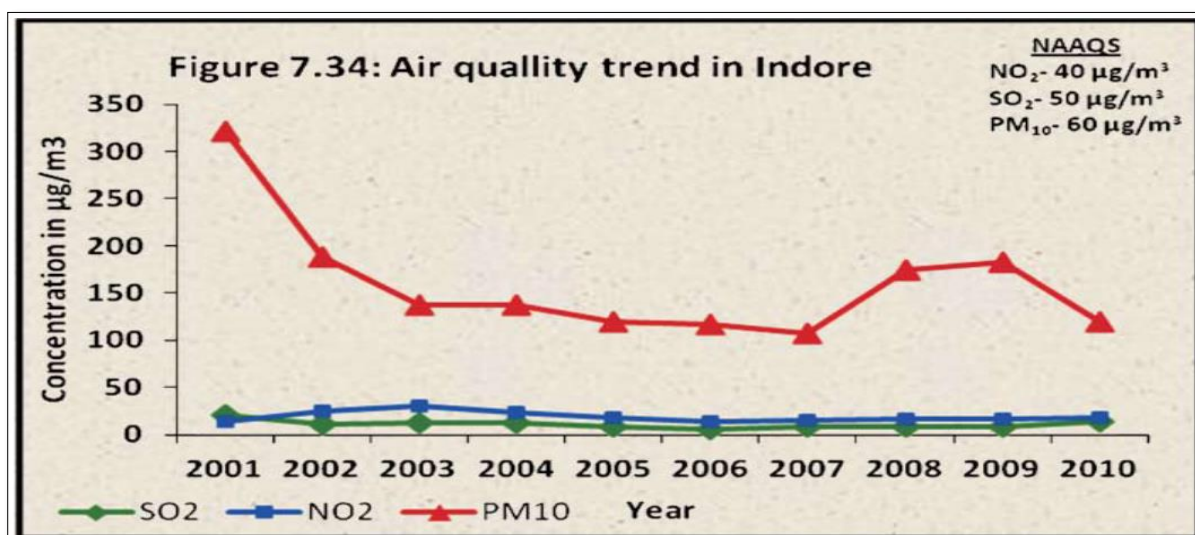
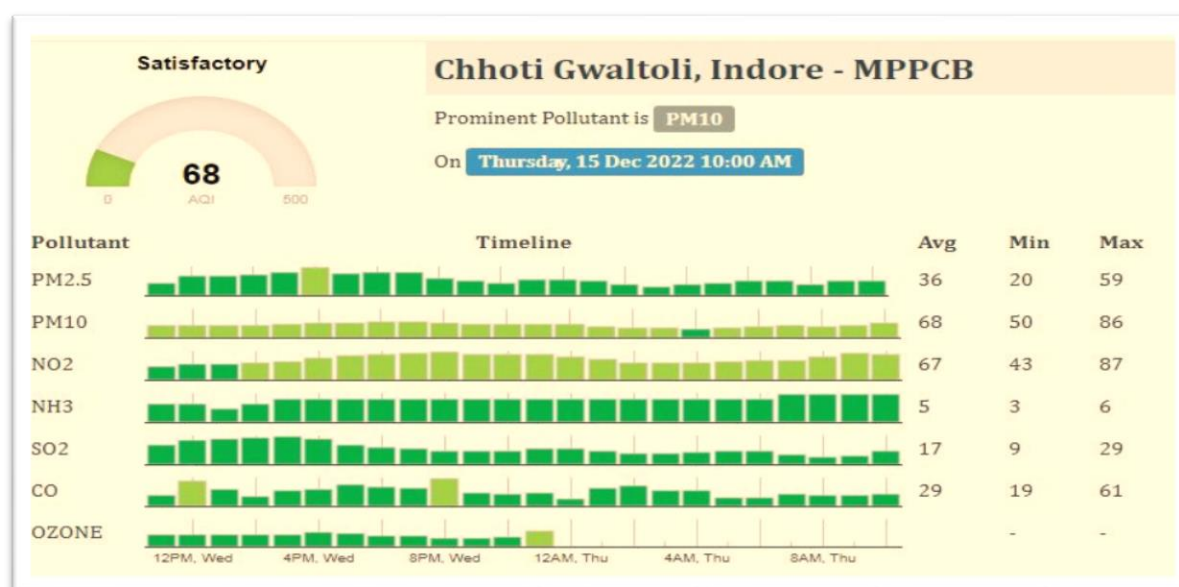


Figure 2. Annual particulate matter (2.5 micrograms) concentration in indore city: 2016-2018



#### 4.1.1 Sulphur dioxide (SO<sub>2</sub>):

SO<sub>2</sub> is the chemical compound produced by volcanoes and in various industrial processes and is also a precursor to particulates in the atmosphere.

#### 4.1.2 Oxides of Nitrogen (NO<sub>x</sub>):

Oxides of nitrogen are a generic term for a group of highly reactive gases that contain nitrogen and oxygen in varying amounts. NO<sub>x</sub> is emitted as nitrogen oxide (NO) which is rapidly oxidized to more toxic nitrogen dioxide (NO<sub>2</sub>). Nitrogen dioxide (NO<sub>2</sub>) is a reddish-brown toxic gas with a characteristic sharp, biting odor and is a prominent air pollutant.

#### 4.1.3 Carbon monoxide (CO):

CO poisoning occurs when carbon monoxide builds up in your bloodstream. When too much carbon monoxide is in the air, your body replaces the oxygen in your red blood cells with carbon monoxide. This can lead to serious tissue damage, or even death. Carbon monoxide is a colorless, odorless, tasteless gas produced by burning gasoline, wood, propane, charcoal, or other fuel. Improperly ventilated appliances and engines, particularly in a tightly sealed or enclosed space, may allow carbon monoxide to accumulate to dangerous levels.

#### 4.1.4 Carbon Dioxide (CO<sub>2</sub>):

Carbon dioxide (CO<sub>2</sub>) is an important heat-trapping gas, or greenhouse gas, that comes from the extraction and burning of fossil fuels (such as coal, oil, and natural gas), from wildfires, and from natural processes like volcanic eruptions. The first graph shows atmospheric CO<sub>2</sub> levels measured at Mauna Loa Observatory, Hawaii, in recent years, with natural, seasonal changes removed. The second graph shows CO<sub>2</sub> levels during Earth's last three glacial cycles, as captured by air bubbles trapped in ice sheets and glaciers.

Since the beginning of industrial times (in the 18th century), human activities have raised atmospheric CO<sub>2</sub> by 50% – meaning the amount of CO<sub>2</sub> is now 150% of its value in 1750. This is greater than what naturally happened at the end of the last ice age 20,000 years ago.

The animated map shows how global carbon dioxide has changed over time. Note how the map changes colors as the amount of CO<sub>2</sub> rises from 365 parts per million (ppm) in 2002 to over 400 ppm currently. ("Parts per million" refers to the number of carbon dioxide molecules per million molecules of dry air.) These measurements are from the mid-troposphere, the layer of Earth's atmosphere that is 8 to 12 kilometers (about 5 to 7 miles) above the ground.

#### 4.1.5 Formaldehyde (HCHO) As a Hazardous Air Pollutant

Formaldehyde (HCHO) is the most important carcinogen in outdoor air among the 187 hazardous air pollutants (HAPs) identified by the U.S. Environmental Protection Agency (EPA), not including ozone and particulate matter. However, surface observations of HCHO are sparse and the EPA monitoring network could be prone to positive interferences. Here we use 2005–2016 summertime HCHO column data from the OMI satellite instrument, validated with high-quality aircraft data and oversampled on a 5 × 5 km<sup>2</sup> grid, to map surface air HCHO concentrations across the contiguous U.S. OMI-derived summertime HCHO values are converted to annual averages using the GEOS-Chem chemical transport model. Results are in good agreement with high-quality summertime observations from urban sites (–2% bias,  $r = 0.95$ ) but a factor of 1.9 lower than annual means from the EPA network. We thus estimate that up to 6600–12 500 people in the U.S.

will develop cancer over their lifetimes by exposure to outdoor HCHO. The main HCHO source in the U.S. is atmospheric oxidation of biogenic isoprene, but the corresponding HCHO yield decreases as the concentration of nitrogen oxides ( $\text{NO}_x \equiv \text{NO} + \text{NO}_2$ ) decreases. A GEOS-Chem sensitivity simulation indicates that HCHO levels would decrease by 20–30% in the absence of U.S. anthropogenic  $\text{NO}_x$  emissions. Thus,  $\text{NO}_x$  emission controls to improve ozone air quality have a significant benefit in reducing HCHO-related cancer risks.

#### 4.1.6 Total Volatile Organic Compounds (TVOC)

**Definition of TVOC** There are different classifications of Total Volatile Organic Compounds (TVOC). Most used is the World Health Organization (WHO) definition<sup>1</sup>, which differentiates the volatility (or boiling point) of organic compounds to define Very Volatile Organic Compounds (VVOCs), Volatile Organic Compounds (VOC) and Semi-Volatile Organic Compounds (SVOCs) as defined in Table 1. This usually involves the molecular length of the carbon structure, i.e., the number of carbon atoms in the chemical formula. The summation of all VOCs is called the Total Volatile Organic Compounds (TVOC). The volume of gas per classification and the sum of all gases (TVOC) are important reflections of the relevant organic compounds found in indoor air. Table 1. Classifications of Volatile Organic Compounds

| Class Name                          | Typical Boiling Point [°C] | Typical Number of Carbon Molecules | Example      |
|-------------------------------------|----------------------------|------------------------------------|--------------|
| VVOC Very Volatile Organic Compound | < 100                      | 0 to 5                             | Formaldehyde |
| VOC Volatile Organic Compound       | 100 to 260                 | 6 to 16                            | Benzene      |
| SVOC Semi Volatile Organic Compound | > 260                      | > 16                               | Phthalate    |

Sum of all TVOC as an Indicator for Indoor Air Quality compounds listed above Figure 1 shows some of the reasons for concern about the TVOC inside buildings. The TVOC is considered an important indicator for indoor hygiene and indoor air quality (IAQ). In addition to serious health concerns, there is the psychological aspect: homes, offices, and other environments that smell clean typically seem more welcoming than areas with foul odors caused by organic compounds.

**Common Volatile Organic Compounds in Indoor Spaces and their Sources** Volatile organic compounds are pervasive both outdoors and indoors. Depending on the interior decoration and usage, a room might be polluted with different organic compounds at the same time. Figure 2 shows typical sources of volatile organic compounds inside a home, and Table 2 gives potential examples and sources for the TVOC. Many volatile organic compounds have a chemical similar structure, which makes it difficult or sometimes impossible to distinguish between these in a VOC gas mixture. More information on detection of the TVOC can be found in Renesas' Application Note – TVOC Sensing.

**Figure 2 Typical Sources of the TVOC inside a Home**

| Chemical Class | Chemical Examples                                                                    | Source                                                                                                                                                                                                                                                                                  |
|----------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Alkanes        | n Butane, n Pentane, n Hexane, n n-Octane, Cyclohexane                               | Heptane, Aerosol spray products for some paints, cosmetics, automotive exhaust products, leather treatments, paint thinner, oil based paints, spot removers, aerosol/liquid insect pest products, mineral spirits, furniture polishes                                                   |
| Alkenes        | Isobutylene, Ethylene                                                                | Solvents, fruit ripening, pest control, rubber production                                                                                                                                                                                                                               |
| Aromatics      | BTEX (Benzene, Toluene, Ethylbenzene, Xylene), Dichlorobenzene, Naphthalene, Styrene | Tobacco smoke, moth balls, moth flakes, deodorizers, air fresheners, automotive exhaust products, paint thinner, oil based paints, aerosol/liquid insect pest products, mineral spirits, furniture polishes, rigid foam products, contact cement, model cement, tar board, plasticizer. |

### 4.1.7 *Particulate Matter (PM)*

PM stands for particulate matter (also called particle pollution): the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using an electron microscope.

Particle pollution includes:

- **PM<sub>10</sub>**: inhalable particles, with diameters that are generally 10 micrometers and smaller; and
- **PM<sub>2.5</sub>**: fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.
- How small is 2.5 micrometers? Think about a single hair from your head. The average human hair is about 70 micrometers in diameter – making it 30 times larger than the largest fine particle.

### 4.1.8 *Particulate Matter 10 (PM 10)*

Using a nationwide network of monitoring sites, EPA has developed ambient air quality trends for particle pollution, also called Particulate Matter (PM). PM<sub>10</sub> describes inhalable particles, with diameters that are generally 10 micrometers and smaller. Under the Clean Air Act, EPA sets and reviews national air quality standards for PM. Air quality monitors measure concentrations of PM throughout the country. EPA, state, tribal and local agencies use that data to ensure that PM in the air is at levels that protect public health and the environment. Nationally, average PM<sub>10</sub> concentrations have decreased over the years.

### 4.1.9 *Particulate Matter 2.5 (PM 2.5)*

Fine particulate matter (PM<sub>2.5</sub>) is an air pollutant that is a concern for people's health when levels in air are high. PM<sub>2.5</sub> are tiny particles in the air that reduce visibility and cause the air to appear hazy when levels are elevated. Outdoor PM<sub>2.5</sub> levels are most likely to be elevated on days with little or no wind or air mixing. The New York State Departments of Health (DOH) and Environmental Conservation (DEC) alert the public by issuing a PM<sub>2.5</sub> Health Advisory when PM<sub>2.5</sub> concentrations in outdoor air are expected to be unhealthy for sensitive groups.

The term fine particles, or particulate matter 2.5 (PM<sub>2.5</sub>), refers to tiny particles or droplets in the air that are two- and one-half microns or less in width. Like inches, meters and miles, a micron is a unit of measurement for distance. There are about 25,000 microns in an inch. The widths of the larger particles in the PM<sub>2.5</sub> size range would be about thirty times smaller than that of a human hair. The smaller particles are so small that several thousands of them could fit on the period at the end of this sentence.

Particles in the PM<sub>2.5</sub> size range can travel deeply into the respiratory tract, reaching the lungs. Exposure to fine particles can cause short-term health effects such as eye, nose, throat and lung irritation, coughing, sneezing, runny nose, and shortness of breath. Exposure to fine particles can also affect lung function and worsen medical conditions such as asthma and heart disease. Scientific studies have linked increases in daily PM<sub>2.5</sub> exposures with increased respiratory and cardiovascular hospital admissions, emergency department visits and deaths. Studies also suggest

that long term exposure to fine particulate matter may be associated with increased rates of chronic bronchitis, reduced lung function and increased mortality from lung cancer and heart disease. People with breathing and heart problems, children and the elderly may be particularly sensitive to PM<sub>2.5</sub>.

#### 4.1.10 Ozone (O<sub>3</sub>):

Ozone is a pale blue gas, soluble in water and nonpolar solvents with a specific sharp odor somewhat resembling chlorine bleach. Ozone is a secondary pollutant formed in the atmosphere by reaction between oxides of nitrogen and volatile organic compounds (VOCs) in the presence of sunlight. Peak O<sub>3</sub> levels occur typically during the warmer times of the year.

#### 4.1.11 Lead (Pb):

Lead is a bright silvery soft, dense, ductile, highly malleable, bluish-white metal that has poor electrical conductivity and is highly resistant to corrosion.



**Maintaining its Heritage, Holkar Science COLLEGE Renovation of Old Roof done**

## 4.2 Ambient Air Quality in the Holkar Science College Campus Area

PRESENCE OF POLLUTION IN AIR QUALITY TESTING AT GOVT. HOLKAR SCIENCE COLLEGE, INDORE ON  
15<sup>th</sup> & 16<sup>th</sup> of DECEMBER 2022

| S. NO. | LOCATION                   | CARBON MONOXIDE (CO) | CARBON DIOXIDE (CO <sub>2</sub> ) | FORMALDEHYDE (HCHO) | TOTAL VOLATILE ORGANIC COMPOUNDS (TVOC) |
|--------|----------------------------|----------------------|-----------------------------------|---------------------|-----------------------------------------|
| 1      | Exam Section               | 10                   | 511                               | 0.023               | 0.2                                     |
| 2      | Library                    | 10                   | 517                               | 0.020               | 0.2                                     |
| 3      | Statics Department         | 11                   | 520                               | 0.025               | 0.2                                     |
| 4      | Zoology Department         | 12                   | 521                               | 0.022               | 0.3                                     |
| 5      | Chemistry department (LAB) | 13                   | 526                               | 0.023               | 0.2                                     |
| 6      | Mathematics                | 11                   | 528                               | 0.023               | 0.2                                     |
| 7      | Bio-Technology             | 10                   | 525                               | 0.023               | 0.1                                     |
| 8      | Physics Department         | 11                   | 524                               | 0.023               | 0.2                                     |
| 9      | Micro-Biology              | 9                    | 509                               | 0.020               | 0.2                                     |
| 10     | Biochemistry               | 11                   | 506                               | 0.020               | 0.3                                     |
| 11     | CSE Department             | 9                    | 519                               | 0.018               | 0.2                                     |
| 12     | Electronics Department     | 10                   | 523                               | 0.024               | 0.2                                     |
| 13     | Forensic Department        | 9                    | 526                               | 0.021               | 0.3                                     |
| 14     | Language Department        | 10                   | 521                               | 0.023               | 0.2                                     |
| 15     | Pharma Department          | 11                   | 523                               | 0.023               | 0.2                                     |
| 16     | Hindi Department           | 12                   | 501                               | 0.021               | 0.3                                     |
| 17     | Canteen Area               | 11                   | 502                               | 0.021               | 0.2                                     |
| 18     | Laboratory Area            | 10                   | 514                               | 0.019               | 0.2                                     |
| 19     | Toilets                    | 9                    | 526                               | 0.023               | 0.2                                     |
| 20     | Open space                 | 12                   | 522                               | 0.020               | 0.3                                     |
| 21     | Playground                 | 12                   | 519                               | 0.021               | 0.3                                     |
| 22     | Under The Tree             | 12                   | 519                               | 0.023               | 0.2                                     |

### 4.2.1 AQI Chart

Presence of pollution in air quality testing at govt. Holkar science college, Indore on 15th and 16th of December 2022

| S. No. | LOCATION                   | AIR QUALITY INDEX (AQI) | PM 2.0 | PM 2.5 | PM 10 | PARTICLE COUNT > 0.3 | PARTICLE COUNT < 0.5 | PARTICLE COUNT > 1.0 | PARTICLE COUNT > 5.0 | PARTICLE COUNT > 10 |
|--------|----------------------------|-------------------------|--------|--------|-------|----------------------|----------------------|----------------------|----------------------|---------------------|
| 1      | Exam Section               | 59                      | 209    | 335    | 356   | 29985                | 1536                 | 3008                 | 100                  | 29                  |
| 2      | Library                    | 54                      | 34     | 53     | 67    | 9124                 | 2368                 | 504                  | 9                    | 3                   |
| 3      | Statics Department         | 73                      | 231    | 325    | 365   | 29965                | 1634                 | 3602                 | 112                  | 30                  |
| 4      | Zoology Department         | 82                      | 263    | 335    | 326   | 29566                | 1425                 | 3456                 | 162                  | 40                  |
| 5      | Chemistry department (LAB) | 87                      | 52     | 82     | 91    | 14221                | 3532                 | 816                  | 15                   | 4                   |
| 6      | Mathematics                | 360                     | 211    | 344    | 398   | 29999                | 1636                 | 3508                 | 101                  | 35                  |
| 7      | Biotechnology              | 90                      | 51     | 75     | 65    | 9025                 | 2036                 | 496                  | 10                   | 5                   |
| 8      | Physics Department         | 66                      | 60     | 55     | 67    | 9125                 | 2236                 | 496                  | 11                   | 3                   |
| 9      | Micro-Biology              | 105                     | 95     | 53     | 79    | 8255                 | 1998                 | 468                  | 12                   | 8                   |

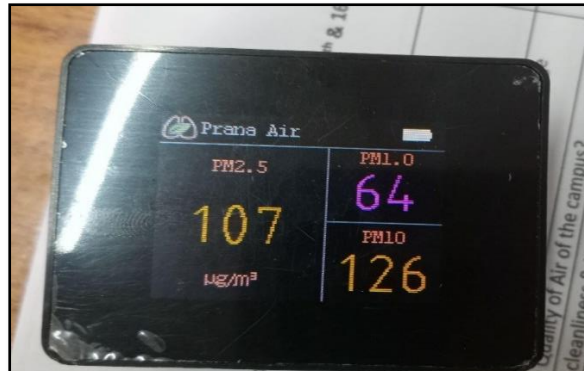
| S. No. | LOCATION               | AIR QUALITY INDEX (AQI) | PM 2.0 | PM 2.5 | PM 10 | PARTICLE COUNT > 0.3 | PARTICLE COUNT < 0.5 | PARTICLE COUNT > 1.0 | PARTICLE COUNT > 5.0 | PARTICLE COUNT > 10 |
|--------|------------------------|-------------------------|--------|--------|-------|----------------------|----------------------|----------------------|----------------------|---------------------|
| 10     | Biochemistry           | 88                      | 209    | 107    | 126   | 29688                | 1433                 | 3624                 | 98                   | 23                  |
| 11     | CSE Department         | 66                      | 60     | 55     | 67    | 9125                 | 2236                 | 496                  | 11                   | 3                   |
| 12     | Electronics Department | 87                      | 52     | 82     | 91    | 14221                | 3532                 | 816                  | 15                   | 4                   |
| 13     | Forensic Department    | 54                      | 34     | 53     | 67    | 9124                 | 2368                 | 504                  | 9                    | 3                   |
| 14     | Language Department    | 87                      | 52     | 82     | 91    | 14221                | 3532                 | 816                  | 15                   | 4                   |
| 15     | Pharma Department      | 86                      | 92     | 51     | 83    | 1552                 | 3522                 | 819                  | 15                   | 4                   |
| 16     | Hindi Department       | 95                      | 209    | 332    | 368   | 29688                | 1433                 | 3624                 | 98                   | 23                  |
| 17     | Canteen Area           | 54                      | 34     | 53     | 67    | 9124                 | 2368                 | 504                  | 9                    | 3                   |
| 18     | Laboratory Area        | 59                      | 209    | 312    | 332   | 29688                | 1433                 | 3624                 | 98                   | 23                  |
| 19     | Toilets                | 87                      | 52     | 82     | 91    | 14221                | 3532                 | 816                  | 15                   | 4                   |
| 20     | Open Space             | 87                      | 52     | 82     | 91    | 14221                | 3532                 | 816                  | 15                   | 4                   |
| 21     | Playground             | 46                      | 209    | 332    | 368   | 29688                | 1433                 | 3624                 | 98                   | 23                  |
| 22     | Under The Tree         | 54                      | 34     | 53     | 67    | 9124                 | 2368                 | 504                  | 9                    | 3                   |



NOTE: Total 13 parameters of Ambient Air Quality was checked at 22 locations in whole campus area. At **mathematics department area AQI was high**, rest other places all parameters were within limits.

The Central Pollution Control Board, New Delhi has set guidelines to monitor and analyze the air pollution quality parameters. The trees covered on the campus are the leading sources to absorb CO<sub>2</sub> and release enough fresh O<sub>2</sub> across the College Campus. The result shows that Holkar Science College Campus's air quality status is good as compared to other locations. It is identified that Holkar Science College's campus is a green campus. College campus observed minimum air pollution as compared to other Ambient Air Pollution Centers located in different parts of the city. More than 50% area of the College is full of lush greenery which has contributed much for its achievement over such an excellent AQI.

## Air Quality Field Test Test



Field test conducted for different parameters of Air Ambient Quality at Holkar College, Indore

## 5.0 Waste Management

**5.1 Objectives:** The overall objectives of the waste management assessment are summarized below:

- (i) To assess the activities involved for the proposed and determine the type, nature and estimated volumes of waste to be generated.
- (ii) To identify any potential environmental impacts from the generation of waste at the site.
- (iii) To recommend appropriate waste handling and disposal measures / routings in accordance with the current legislative and administrative requirements; and
- (iv) To categorize waste material where practicable (inert material / waste fractions) for disposal considerations i.e., public filling areas / landfill.

### 5.2 Solid Waste Management:

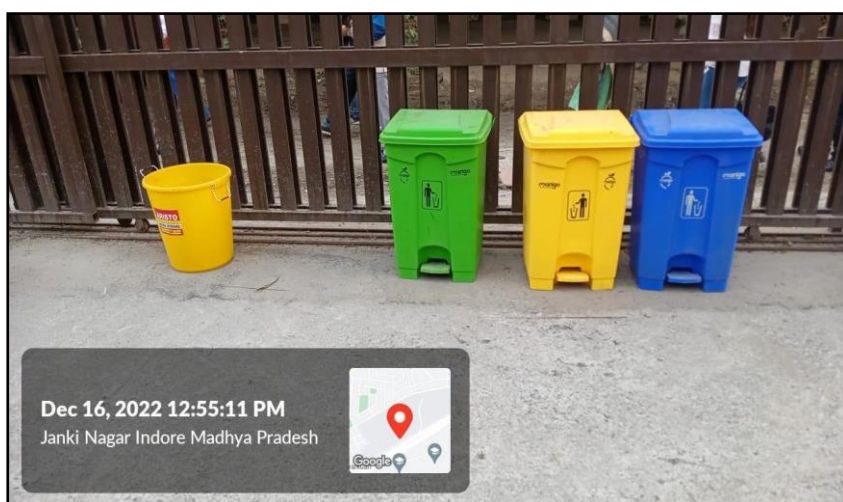
To reduce waste at institute, **students and staff are educated on proper waste management practices through lectures, advertisement on notice boards, displaying slogan boards in the campus.** Waste is collected daily from various sources and is separated as dry and wet waste.

#### 5.2.1 Campus solid waste management program

The main objectives of SWM are the **maintenance of clean and hygienic conditions and reduction in the quantity of solid waste (SW)**, which is disposed of in the sanitary landfill facility (SLF) of the area after recovery of material and energy from it. Student participation in waste management will play very important role as they will also spread awareness programs along with their duty towards cleanliness.

#### 5.2.2 Producing less wastes:

1. Students can utilize their belongings like paper, pencils and pens to the maximum and produce less amounts of wastes.
2. Keeping classrooms and households clean: The students can keep their classrooms and houses clean by not littering things here and there. Methods of disposal of solid waste management



Different dust bins were placed at Locations to collect various waste

### 5.2.3 Here are the methods of solid waste disposal and management:

- Solid Waste Open Burning.
- Sea dumping process.
- Solid wastes sanitary landfills.
- Incineration method.
- Composting process.
- Disposal by Ploughing into the fields.
- Disposal by hog feeding.
- Salvaging procedure.
- Benefits of waste management
- Reducing waste will not only protect the environment but will also **save on costs or reduce expenses for disposal**. In the same way, recycling and/or reusing the waste that is produced benefits the environment by lessening the need to extract resources and lowers the potential for contamination.

### The 7 principles of waste management-



### 5.2.4 The 7 R's of Recycling

- Recycle.
- Refuse.
- Reduce.
- Reuse.
- Repair.
- Re-gift.
- Recover.

## 5.3 Municipal Solid Waste

Top 3 items in municipal solid waste

In 2018, about 146.1 million tons of MSW were land filled. Food was the largest component at about 24 percent. Plastics accounted for over 18 percent, paper and paperboard made up about

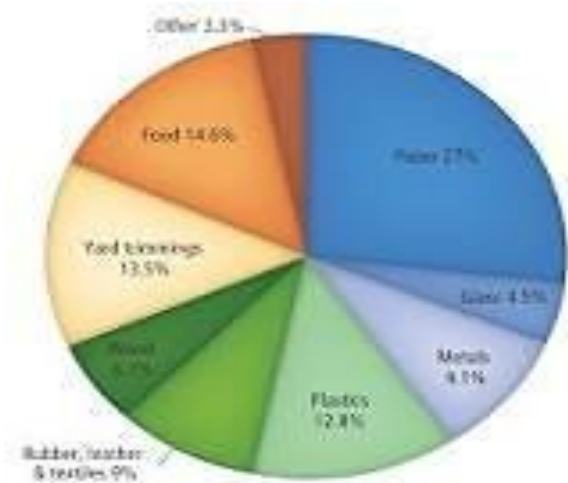
12 percent, and rubber, leather and textiles comprised over 11 percent. Other materials accounted for less than 10 percent each.



Figure1: Municipal Solid Waste being taken for disposal outside the campus.

Solid Waste Management may be defined as the discipline associated with the control of generation, collection, storage, transfer and transport, processing, and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other ...

The major sources of municipal solid waste



Municipal Solid Waste (MSW)—more commonly known as trash or garbage—consists of everyday items we use and then throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. This comes from our **homes, schools, hospitals, and businesses**.

#### 5.4 Plastic Waste

India has banned manufacture, import, stocking, distribution, sale and use of identified **single use plastic items**, which have low utility and high littering potential, all across the country from July 1, 2022.

Recently, the **Ministry of Environment, Forest, and Climate Change** announced the **Plastic Waste Management (Amendment) Rules, 2022**, which notified the instructions on **Extended Producer Responsibility (EPR)** for plastic packaging.

### **5.5 Centralized Online Portal:**

- A. The government has also called for **establishing a centralized online portal** by **Central Pollution Control Board (CPCB)** for the registration as well as filing of annual returns by producers, importers and brand-owners, plastic waste processors of plastic packaging waste by 31st March, 2022.
- B. It would act as the **single point data repository with respect to orders** and guidelines related to implementation of EPR for plastic packaging under **Plastic Waste Management Rule, 2016**.

### **5.6 Environmental Compensation:**

Environmental compensation will be levied based upon polluter pays principle, with respect to non-fulfillment of EPR targets by producers, importers, and brand owners, for the purpose of protecting and improving the quality of the environment and preventing, controlling, and abating environment pollution. The Polluter Pays Principle imposes liability on a person who pollutes the environment to compensate for the damage caused and return the environment to its original state regardless of the intent.

### **5.7 Committee to Recommend Measures:**

A **committee** constituted by the **CPCB** under the chairmanship of **CPCB chairman** will recommend measures to the environment ministry for effective implementation of EPR, including amendments to **Extended Producer Responsibility (EPR) guidelines**.

### **5.8 Construction & Demolition waste:**

The **Bureau of Indian Standards** has allowed the use of concrete made from recycled material and **processed C&D waste**. The **Construction and Demolition Waste Rules and Regulations, 2016** have mandated reuse of recycled material. Even the **Swachh Bharat Mission** has recognized the need for C&D waste management.

#### **5.8.1 Construction and demolition waste management**

Construction and demolition waste is **generated whenever any construction/demolition activity takes place**, such as, building roads, bridges, flyover, subway, remodeling etc. It consists mostly of inert and non-biodegradable material such as concrete, plaster, metal, wood, plastics etc.

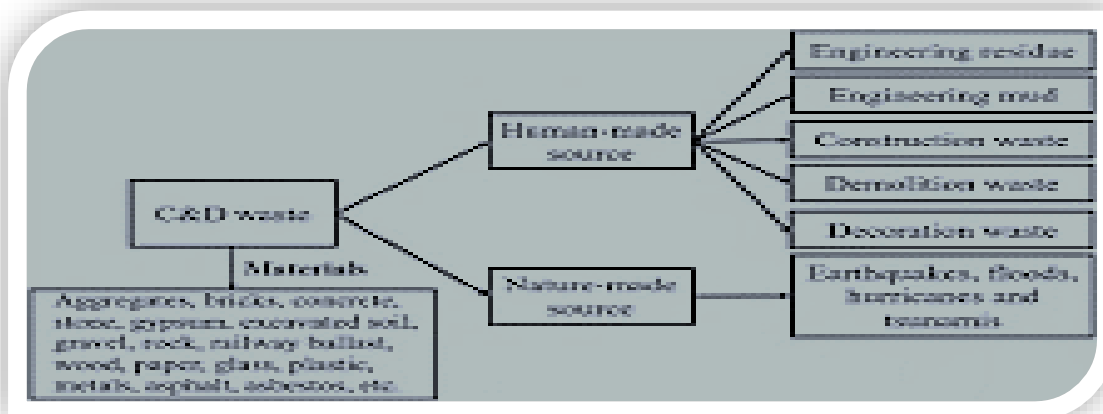
C&D waste includes bricks, tiles, stone, soil, rubble, plaster, drywall or gypsum board, wood, plumbing fixtures, non-hazardous insulating material, plastics, wallpaper, glass, metal (e.g., steel, aluminum), asphalt, etc.

### 5.8.2 Recycle the Construction and Demolition waste



Demolition of Construction Waste & proper disposal

Recycling construction and demolition waste is profitable and environmental way to produce aggregates and reuse valuable materials that would otherwise be disposed. Processing the waste



near the worksites also reduces the need for truck transportation resulting in lower logistics costs. the impact of construction and demolition waste on the environment.

The environmental impacts caused by C&D waste mainly include **land space consumption, landfill depletion, energy and non-energy resource consumption, resource depletion, air pollution, noise pollution, water pollution**, etc. (Akanbi et al., 2018).

### 5.9 SOLID WASTE AUDIT

Solid waste is the unwanted or useless solid material generated from human activities in a residential, industrial, or commercial area. Solid waste management reduces or eliminates the adverse impact on the environment and human health. A number of processes are involved in efficiently managing waste for an organization. It is necessary to manage the solid waste properly to reduce the load on the waste management system. Solid waste generation and its management is a burning issue in current days. The rate of generation of solid waste is very high and yet we do not have adequate technology to manage the generated waste. Unscientific handling of solid waste can create threats to public health and environmental safety issues.

Thus, it is necessary to manage solid waste properly to reduce the load on the waste management system. The purpose of this audit is to find out the quantity, volume, type, and current management practice of solid waste generation in the Holkar Science College campus. This report will help for further solid waste management and to go for green campus development.

### *5.10 Generation of solid waste in Holkar Science College*

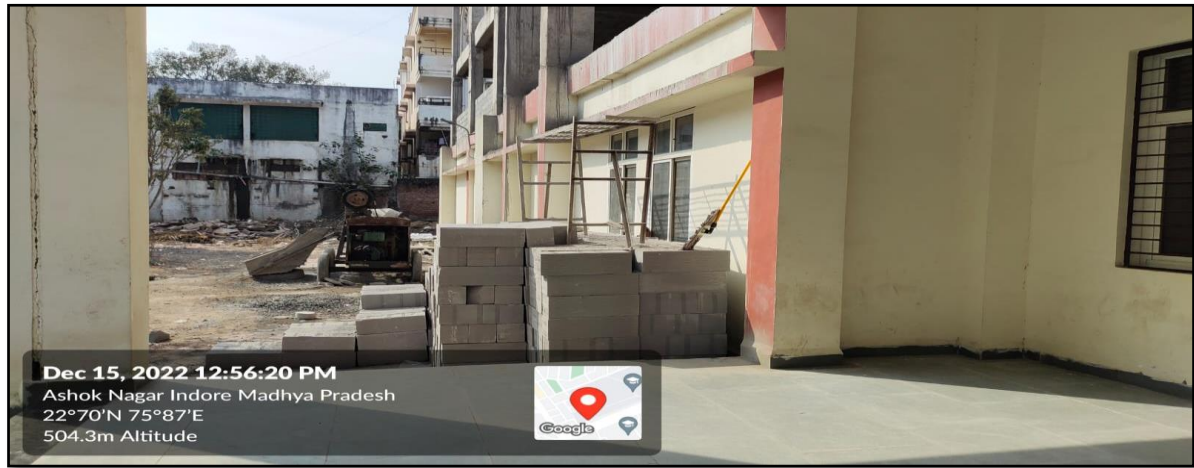
Holkar Science College campus solid waste data is collected from all the building areas and the same is directly handed over to the Municipalities' Bin for further segregation and recycling purposes. There are different types of waste are recorded such as paper waste, plastic waste, construction waste, glass waste, etc. However biodegradable waste is recycled through the vermicomposting process. The daily rate of waste generation has been increasing in recent time reaching up to an estimated amount of about 2 tons per day (tpd) during peak academic sessions and the minimum amount generated during the lean period is about 0.5 tpd.

The wastes generated in the campus include (i) kitchen wastes, (ii) wastes from construction sites, (iii) liquid waste (residential and eateries), (iv) sewage and sludge, (v) biomedical waste, (vi) laboratory chemical wastes, (vi) Plastic wastes, (vii) cans and bottles; (viii) damaged or spoiled laboratory glassware, (ix) Unused tools and machinery including battery, (xi) papers including packaging materials (xii) electronics waste (xiii) garden leaves and (xiv) sweeping litters, etc.

**Proper segregation of waste can fetch more revenue to the College.**

### *5.11 Status of solid waste generation in Holkar Science College Campus*

The College is committed to ensuring that all forms of wastes generated are handled based on the RRRR (Reduce, Reuse, Recycle, Recover) principles following appropriate source segregation protocols including safe disposal of bio, medical and hazardous wastes. There are studies from time to time to estimate the amount and nature of wastes, particularly solid waste which indicates the increasing trend of the volume. A preliminary survey reveals the domination of biodegradable components (volume basis) over the non-biodegradable counterparts on the campus. The students' hostels share the highest amount of solid waste mostly dominated by food/kitchen wastes (substantial amount of papers, plastics, metals are also seen with waste also generated in hostels) followed by residential areas, eateries including shopping complex and offices including academic buildings, construction sites (occasionally), open areas including gardens and roads.



Holkar college is using hollow bricks which are best for heat insulation & economical.

## 5.12E-Waste

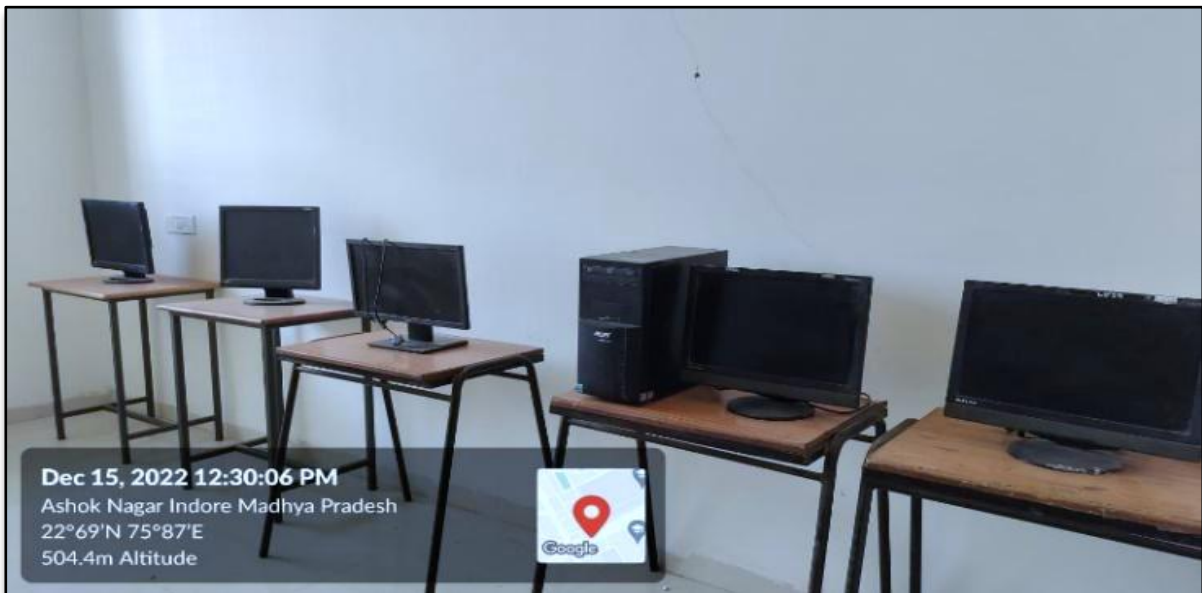
### 5.12.1 Importance of e-waste management

It's critical to keep electronic waste out of landfill the EPA has stated that **e-waste is dangerous when improperly disposed of**. Electronic devices are composed of toxic substances and heavy metals. Materials such as chromium, cadmium, mercury, and lead can leach into the soil contaminating the air and waterways. New Gazette Notification is being implemented from 1<sup>st</sup> April 2023.

### 5.12.2 Five Reasons Why E-Waste Recycling is Important

Everyone has one. That box, drawer or shopping bag in a closet filled with old cell phones, obsolete chargers, broken tablets, and defunct MP3 players. It's our personal pile of electronic waste. According to government agencies, these piles are getting bigger, forcing us to consider why e-waste recycling is important.

Recycling electronic waste (e-waste, sometimes called e-scrap has become an increasingly important environmental issue as the useful life of electronic devices becomes shorter and shorter and the list of electronic gadgets we use becomes longer and longer. E-waste recycling benefits are numerous and the need to address these items in the solid waste stream is becoming more urgent.



E-Waste kept Neatly for disposal

There are many factors to consider when evaluating electronics recycling, but here are the most significant reasons why e-waste recycling is important.

### 5.12.3 It's critical to keep electronic waste out of landfills:

The EPA has stated that e-waste is dangerous when improperly disposed of. Electronic devices are composed of toxic substances and heavy metals. Materials such as chromium, cadmium, mercury, and lead can leach into the soil contaminating the air and waterways. EPA estimates there are about 60 million tons of e-waste per year globally. Recycling this material will save landfill space. For these reasons, there are numerous state laws that now ban e-waste in landfills.

#### **5.12.4    *Electronic products:***

These are valuable materials such as precious metals like gold, silver, and platinum along with copper, aluminum, plastic and glass. Through the recycling process, these materials can be reclaimed. Most electronic devices are nearly 100 percent recyclable. It would be poor stewardship to landfill these materials.

#### **5.12.5    *Reclaiming valuable materials:***

Reclaiming valuable materials from the recycling process means there will be decreased demand for new raw materials. This will help conserve important natural resources. According to the EPA, one metric ton of circuit boards contains 800 times the amount of gold mined from one metric ton of ore.

#### **5.12.6    *Using recycled material:***

Using recycled material will also help reduce greenhouse gas emissions produced when manufacturing or processing new products known as “virgin material.” The more recycled material is available, the lower the demand for virgin material.

#### **5.12.7    *Discarded electronic devices:***

Discarded electronic devices can also be kept out of the landfill if they are refurbished, reused, and donated to a worthy cause. A quick Google search will provide a list of organizations in most areas that rebuild old electronics and provide them to those who otherwise would go without. “Reuse” is an important component of keeping material out of the waste stream.

Holkar Science College is planning to segregate its E - Waste for further disposal to recyclers. For this they have already initiated the process. Also, in future they have agreed to file E-Waste returns also.

#### **5.12.8    *Single use Plastic restriction in campus Area***

From 1<sup>st</sup> July 2022, single use plastic is banned all over India. It is expected from the College that posters and handbills to be pasted around the campus and those who find throwing of single use plastic in campus area to be fined. Student groups are encouraged to take active participation and watch and educate all that not to throw such plastic in the campus area. This can be achieved through awareness and participation only. It is recommended to put slogans for **NO PLASTIC ZONE** or such different types of slogans. A competition among the students shall be conducted to give different suggestions for **Slogans**. The best selected Slogans to be suitably rewarded or certificate to be issued to that student. Plastics are a good source of fuel also.

### **6   *Hazardous Waste Management***

#### **6.1   *The Importance of Chemical Lab Waste Disposal for Colleges and Colleges:***

To protect the safety and health of your college and its surrounding environment and community, it is required to implement proper chemical waste management. State and federal regulations require that all generators of chemical waste follow the correct disposal procedures and waste management in their facilities. Millions of dollars in fines have been levied against universities that do not comply with the EPA's environmental waste management procedures in the United States.

#### **6.2   *Chemical Lab Waste at Holkar Science College:***

The United States Environmental Protection Agency (EPA) defines chemical waste. Examples of some chemical waste material include:

- By-products created from educational and research experiments
- Surplus and unused reagent grade chemicals
- Any items that have been contaminated by chemicals
- Batteries
- Used oils
- Items containing mercury
- Pesticides
- Chemically contaminated sharps
- Contaminated needles, razor blades, pipette tips, pipettes, syringes
- Fluorescent light bulbs
- Preserved specimens
- And much more- check with your local hazardous waste disposal service for a more complete list.

### 6.2.1 Need Proper Disposal Procedures for Chemical Lab Waste at Holkar Science College

It is the responsibility of all research and teaching staff to make sure the proper disposal of waste materials is followed according to EPA guidelines in the United States. Irresponsible or improper disposal of your chemical waste to the local refuse collection, into the atmosphere, or down the drains is forbidden by law.

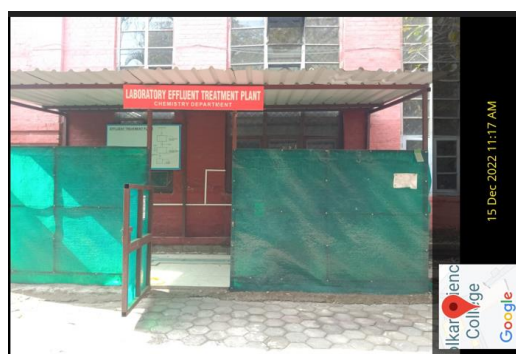
The new legislation, along with increasingly strict environmental controls, makes it essential that appropriate disposal procedures are followed to avoid stiff fines being imposed on your college. These are some of the disposal methods your college should be following:

There are some materials on the EPAs 'red list' that should never be washed down your drains:

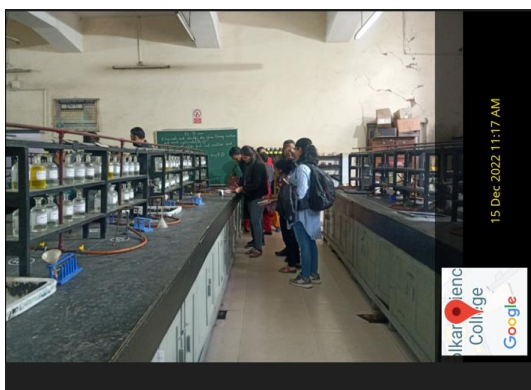
- organ halogen, organonitrogen pesticides, triazine herbicides, or any biocides
- cyanides
- compounds with the following elements- barium, beryllium, boron, chromium, cobalt, copper, lead, mercury, nickel, silver, tin, titanium, zinc
- hydrocarbons or mineral oils
- nitrites or fluorides
- poisonous compounds, metal phosphides or phosphorus elements
- This is a partial list of chemicals- to check with the local hazardous waste disposal service for a complete list to ensure you do not pour any dangerous chemicals down the drain.



Chemistry Lab



Effluent Treatment plant



Nearliness & tidiness of Chemistry lab



Collection chamber of Chemical waste

### 6.2.2 Waste Bins and Controlled Waste Disposal

In United States, not abiding by the regulations and laws will lead to college failing an inspection when the EPA, OSHA, or RCRA perform a routine examination of campus facilities. If an inspection fails, not only will it be costly, but these inspections are disruptive and can leave the College with a negative reputation.

Any waste suitable for local garbage services, other than glass and paper is considered controlled waste. This waste includes your dirty paper, rubber, plastic, and wood and should be placed in waste bins. Waste bins should be available in all labs and collected daily through your regular cleaning services.

Each of the labs must have a container for specific wastes that are not allowed to go with normal waste bins. In one of these special containers, should have it labeled to hold all broken lab glassware, sharp objects such as glass or metals, fine powders (which should first be placed into a glass container), dirty sample tubes, and any other contaminated chemicals that are not needles or syringes.

The lab-controlled waste containers are required to be emptied on a regular basis and should never be allowed to overflow. It should never be allowed to place any glass, fine powder, or sharp metal into a standard lab waste bin. Before placing bottles into the waste container, remove their tops, and make sure there is no detectable smell of chemicals coming from the bottles.

### 6.2.3 Risks of Improperly Handled Lab Waste

Exposure to toxic chemicals, reactions, explosions, fires, or spills is all possible risks when the chemical wastes are not disposed of and handled properly. These possible situations pose threats to staff and students as well as other people in the area.

People's lives can be at risk, or the possibility of serious injuries is present from not complying with state and federal laws when it comes to managing your college's hazardous waste. College administration should check with local hazardous waste disposal service, which is authorized to move and touch lab waste in a manner that minimizes potential risks to your staff and students.

### 6.2.4 Environmental Hazards from Improperly Handled Lab Waste

Students and staff members are not the only one's subject to risks from mishandled lab waste. The environment can also suffer serious consequences. Leachate, contamination, and pollution are all negative effects from hazardous waste, and will seriously leave a mark on the environment if College does not handle them properly.

When waste from the labs is eventually removed from the facility, it not only affects individuals such as staff and students, but it can also ultimately affect society. *Lab waste is disposed of through three routes: into the atmosphere through gaseous effluent from incineration or evaporation, into our oceans, rivers, or other waterways through sewer systems and wastewater treatment facilities, and finally into landfills.*

In labs, the workers who are generating lab waste have an obligation to consider the fate of their used materials that they've created from their work. The lab workers need to be aware of the significant impact their disposal materials will have on people outside the lab, and how they will affect the environment around college and the surrounding community.

### **6.2.5 Workers Impact Proper Lab Waste Disposal**

Materials become a waste by regulatory definition or a generator's decision, and the first responsibility for it being properly disposed of is in the hands of the lab worker. These workers are in the best place to know the characteristics of the materials they have synthesized or used. It is the lab worker's responsibility to assess the risks associated with the waste and evaluate it. It is the lab worker's choice on which strategy to handle; they must minimize or dispose of lab waste.

Lab workers have numerous sources available to them to help with making the decision on how to dispose of their lab waste. It can also have them check with the local hazardous waste disposal service for guidance on how to properly dispose of dangerous lab wastes.

### **6.2.6 Risk of Serious Injuries from Mismanaged Lab Waste in Colleges/Universities**

In United States the EPA has discovered forgotten chemicals in college stockrooms through routine inspections of their laboratories. They have created a pattern of hazardous waste management problems in these research labs with their wastes being left, sometimes for decades, in damaged containers. Some of these containers are even labeled as 'unknown' and some chemicals have been kept in temperatures that could cause them to explode.

Laboratories in universities and medical research centers use a large variety of chemicals that perform an extensive range of work. If labs in college are not managed properly, they will endanger both the workers in the lab and the community surrounding your college. The most serious problems these mishandled lab wastes can inflict include death.

To improve chemical lab waste management, the EPA (Environmental Protection Agency) created outlines on how to properly dispose of these hazardous materials through the RCRA (Resource Conservation and Recovery Act.) They have also created workshops, encouraged self-auditing of college labs, provided compliance assistance, and in some cases, taken enforcement actions.

In one case involving the College of California, the EPA located numerous violations of hazardous waste requirements, many of which the College disclosed on their own accord. The violations were stated to include more than 4,000 containers of hazardous lab waste. Some of these wastes included reactive cyanide, corrosive acid, ignitable paint, and photochemical waste.

**It was reported that the College had to spend almost two million dollars and over 23,000 staff hours to complete environmental audits in forty-seven of their college facilities, their agricultural research stations, campuses, medical and vet schools, and other various facilities. The EPA did reduce the penalties for many of the violations when the College agreed to Incentives for Self-Policing.**

It can now see the importance of proper chemical lab waste disposal at your college. Proper handling will save the facility millions of dollars trying to correct mismanagement if it is discovered

by the EPA. When you routinely follow proper management, you will have no concerns when it's time for an audit of college.

It will not only save individuals and College unnecessary expenses; one will protect the soil, air, wildlife health, and water in the environment and that of the surrounding community. Regulations to dispose of lab waste properly exist to help one know how to handle your hazardous chemicals. If anyone is unsure which procedures apply to the materials in the college lab, contact the local hazardous waste disposal service, and they will help. This service can come into the lab and show how to label, store and dispose of all lab waste safely and properly.

**The management of hazardous waste is a process which includes the collection, recycling, treatment, transportation, disposal, and monitoring of wastes disposal sites.** In the current scenario of developing countries, hazardous wastes are often disposed directly into the environment posing health and environmental risk.

### 6.2.7 Responsibilities

- Hazardous-waste characteristics.
- Transport of hazardous waste. Transport vehicles. The manifest system.
- Treatment, storage, and disposal. Treatment. Surface storage and land disposal. Secure landfills.
- Remedial action.

### 6.2.8 Procedure

Hazardous waste can be treated by **chemical, thermal, biological, and physical methods**. Chemical methods include ion exchange, precipitation, oxidation and reduction, and neutralization. Among thermal methods is high-temperature incineration, which not only can detoxify certain organic wastes but also can destroy them.

### 6.2.9 Objectives

Hazardous Waste Management Rules are notified to ensure safe handling, generation, processing, treatment, package, storage, transportation, use, reprocessing, collection, conversion, and offering for sale, destruction, and disposal of Hazardous Waste.

## 6.3 Practice adopted in India

**Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016 with amendments:**

Responsibilities of the occupier for management of hazardous and other wastes. -

- (1) For the management of hazardous and other wastes, an occupier shall follow the following steps, namely: -(a) prevention; (b) minimization; (c) reuse, (d) recycling; (e) recovery, utilization including co-processing; (f) safe disposal.
- (2) The occupier shall be responsible for safe and environmentally sound management of hazardous and other wastes.
- (3) The hazardous and other wastes generated in the establishment of an occupier shall be sent or sold to an authorized actual user or shall be disposed of in an authorized disposal facility.
- (4) The hazardous and other wastes shall be transported from an occupier's establishment to an authorized actual user or to an authorized disposal facility in accordance with the provisions of these rules.

(5) The occupier who intends to get its hazardous and other wastes treated and disposed of by the operator of a treatment, storage and disposal facility shall give to the operator of that facility, such specific information as may be needed for safe storage and disposal.

(6) The occupier shall take all the steps while managing hazardous and other wastes to- 5  
(a) contain contaminants and prevent accidents and limit their consequences on human beings and the environment; and (b) provide persons working in the site with appropriate training, equipment, and the information necessary to ensure their safety.

Grant of authorization for managing hazardous and other wastes. -

(1) Every occupier of the facility who is engaged in handling, generation, collection, storage, packaging, transportation, use, treatment, processing, recycling, recovery, pre-processing, co-processing, utilization, offering for sale, transfer or disposal of the hazardous and other wastes shall be required to make an application in Form 1 to the State Pollution Control Board and obtain an authorization from the State Pollution Control Board within a period of sixty days from the date of publication of these rules. Such application for authorization shall be accompanied with a copy each of the following documents, namely: -

(a) consent to establish granted by the State Pollution Control Board under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981 (21 of 1981);

(b) Consent to operate granted by the State Pollution Control Board under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and/or Air (Prevention and Control of Pollution) Act, 1981, (21 of 1981).

(c) in case of renewal of authorization, a self-certified compliance report in respect of effluent, emission standards and the conditions specified in the authorization for hazardous and other wastes: Provided that an application for renewal of authorization may be made three months before the expiry of such authorization: Provided further that-

(i) any person authorized under the provisions of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008, prior to the date of commencement 6 (ii) of these rules, shall not be required to make an application for authorization till the period of expiry of such authorization; any person engaged in recycling or reprocessing of the hazardous waste specified in Schedule IV and having registration under the provisions of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008, shall not be required to make an application for authorization till the period of expiry of such registration.

(2) On receipt of an application complete in all respects for the authorization, the State Pollution Control Board may, after such inquiry as it considers necessary, and on being satisfied that the applicant possesses appropriate facilities for collection, storage, packaging, transportation, treatment, processing, use, destruction, recycling, recovery, pre-processing, co-processing, utilization, offering for sale, transfer or disposal of the hazardous and other waste, as the case may be, and after ensuring technical capabilities and equipment complying with the standard operating procedure or other guidelines specified by the Central Pollution Control Board from time to time and through site inspection, grant within a period of one hundred and twenty days, an authorization in Form 2 to the applicant, which shall be valid for a period of five years subject to such conditions as may be laid down therein. For commonly recyclable hazardous waste as given in Schedule IV, the guidelines already prepared by the Central Pollution Control Board shall be followed: Provided that in the case of an application for renewal of authorization, the State Pollution Control Board may, before granting such authorization, satisfy itself that

there has been no violation of the conditions specified in the authorization earlier granted by it and same shall be recorded in the inspection report.

(3) The authorization granted by the State Pollution Control Board under sub-rule (2) shall be accompanied by a copy of the field inspection report signed by that Board indicating the adequacy of facilities for collection, storage, packaging, transportation, treatment, processing, use, destruction, recycling, recovery, pre-processing, co-processing, utilization, offering for sale, transfer or disposal of the hazardous and other wastes and compliance to the guidelines or standard operating procedures specified by the Central Pollution Control Board from time to time.

(4) The State Pollution Control Board may, for the reasons to be recorded in writing and after giving reasonable opportunity of being heard to the applicant, refuse to grant any authorization under these rules.

(5) Every occupier authorized under these rules, **shall maintain a record of hazardous and other wastes managed by him in Form 3** and prepare and submit to **the State Pollution Control Board, an annual return containing the details specified in Form 4 on or before the 30th day of June** following the financial year to which that return relates.

(6) The State Pollution Control Board shall maintain a register containing particulars of the conditions imposed under these rules for management of hazardous and other wastes and it shall be open for inspection during office hours to any interested or affected person.

(7) The authorized actual user of hazardous and other wastes shall maintain records of hazardous and other wastes purchased in a passbook issued by the State Pollution Control Board along with the authorization.

(8) Handing over of the hazardous and other wastes to the authorized actual user shall be only after making the entry into the passbook of the actual user.

Storage of hazardous and other wastes. - (1) The occupiers of facilities may store the hazardous and other wastes for a period not exceeding ninety days and shall maintain a record of sale, transfer, storage, recycling, recovery, pre-processing, co-processing and utilization of such wastes and make these records available for inspection: **Provided that the State Pollution Control Board may extend the said period of ninety days** in following cases, namely: - (i) (ii) (iii) (iv) (v)

(9) small generators (up to ten tons per annum) up to one hundred and eighty days of their annual capacity; actual users and disposal facility operators up to one hundred and eighty days of their annual capacity, occupiers who do not have access to any treatment, storage, disposal facility in the concerned State; or the waste which needs to be specifically stored for development of a process for its recycling, recovery, pre-processing, co-processing or utilization; in any other case, on justifiable grounds up to one hundred and eighty days.

## **6.4 TREATMENT, STORAGE AND DISPOSAL FACILITY FOR HAZARDOUS AND OTHER WASTES**

Treatment, storage, and disposal facility for hazardous and other wastes. -

(1) The State Government, occupier, operator of a facility or any association of occupiers shall individually or jointly or severally be responsible for identification of sites for establishing the facility for treatment, storage, and disposal of the hazardous and other waste in the State.

(2) The operator of common facility or occupier of a captive facility shall design and set up the treatment, storage, and disposal facility as per technical guidelines issued by the Central Pollution Control Board in this regard from time to time and shall obtain approval from the State Pollution Control Board for design and layout in this regard.

(3) The State Pollution Control Board shall monitor the setting up and operation of the common or captive treatment, storage, and disposal facility, regularly.

(4) The operator of a common facility or occupier of a captive facility shall be responsible for safe and environmentally sound operation of the facility and its closure and post closure phase, as per guidelines or standard operating procedures issued by the Central Pollution Control Board from time to time.

(5) The operator of a common facility or occupier of a captive facility shall maintain records of hazardous and other wastes handled by him in Form 3.

(6) The operator of a common facility or occupier of a captive facility shall file an annual return in Form 4 to the State Pollution Control Board on or before the 30th day of June following the financial year to which that return relates.

## 7 Acid from Labs

### 7.1 Disposal of Acid in a Lab:

Some of these methods are:

- (a) Recycling/reuse of the chemicals.
- (b) Incineration and disposal in landfills of incineration ash.
- (c) Disposal in landfills of stabilized chemical waste, or non-hazardous waste; and
- (d) Disposal in sewers of neutralized, non-toxic chemicals.

#### 7.1.1 How to dispose of acid solutions

Carefully pour one-quarter to one-half-cup of the hydrochloric acid into 2 to 5 gallons of water. It's very important to always add the chemical to the water and not the water to the chemical. **Pour the diluted solution down the sink, flushing with large amounts of water.** Work slowly to avoid splashes.

#### 7.1.2 Types of waste generated from a lab

This waste can be broken down into a few categories: **Hazardous; Clinical; Biological; Electrical; Laboratory.** Reducing laboratory waste will have several benefits, saving money and reducing disposal costs while also encouraging safety in the lab.

#### 7.1.3 Handling and disposal of laboratory waste

**Waste disposal - disposal of laboratory wastes (guidance)**

1. Disposal Procedures.
2. Wash Down Drains with Excess Water.
3. Incineration.
4. Laboratory Waste Bins and Controlled Waste.
5. Waste for Special Disposal.
6. Glass Recycling.
7. Bottles for Bulk Solvents.
8. Biohazard/Sharps Disposal - Syringes and Needles.

#### 7.1.4 Types of laboratory waste

1. Clinical laboratories generate three primary types of waste: **chemical waste, infectious (biohazard) waste, and pathological (large tissue) waste.** This section contains information on correct disposal as well as environmental best practice for managing laboratory wastes.
2. **Dispose of sulfuric acid in a lab**
3. Sulfuric acid may also be diluted and then neutralized. One method of neutralization is to add the acid slowly to a solution of soda ash and slaked lime, and to then flush with a large

volume of water. Once sulfuric acid is diluted and neutralized it can be **discharged to a sewer**.

4. **Neutralizing HCl in disposal**
5. Decontamination/Waste Disposal Procedure Spills may be neutralized with **sodium bicarbonate or baking soda**. Do not dispose of HCl by pouring down drains followed by copious amounts of water without neutralization.

## 7.2 *Disposal of proper chemical hazardous waste in the laboratory*

### 7.2.1 *Caps and closure:*

1. Use waste containers with leak-proof, screw-on caps so contents can't leak if a container tips over. ...
2. If necessary, transfer waste material to a container that can be securely closed. ...
3. Keep waste containers closed except when adding waste.
4. Wipe down containers prior to your scheduled collection date.

### 7.2.2 *Responsibilities*

1. Hazardous-waste characteristics.
2. Transport of hazardous waste. Transport vehicles. The manifest system.
3. Treatment, storage, and disposal. Treatment. Surface storage and land disposal. Secure landfills.
4. Remedial action.

## 8 *Bio-Medical Waste*

There are generally 4 different kinds of medical waste: **infectious, hazardous, radioactive, and general** 1000 kg/month – reuse through vermicomposting.

### 8.1 *Types of Bio-medical waste*

1. Human anatomical waste like tissues, organs, and body parts.
2. Animal wastes generated during research from veterinary hospitals.
3. Microbiology and biotechnology wastes.
4. Waste sharps like hypodermic needles, syringes, scalpels, and broken glass.
5. Discarded medicines and cytotoxic drugs.
6. What is the rule of bio-medical waste?
7. Amendments in Bio-Medical Waste Management Rules, 2016 Rules. The amended rules stipulate those generators of bio-medical waste such as hospitals, nursing homes, clinics, and dispensaries etc. will not use chlorinated plastic bags and gloves beyond March 27, 2019, in medical applications to save the environment.
8. Who is responsible for biomedical waste management?
9. The responsibility of each state to check for compliance will be done by setting up **district-level committee under the chairpersonship of District Collector or District Magistrate or Additional District Magistrate**. In addition, every 6 months, this committee shall submit its report to the State Pollution Control Board.
10. Biomedical waste management is important
11. Biomedical waste management is of great significance because **biomedical waste can adversely affect health inviting serious implications to the people who get in touch with it.**

Segregation, storage and safe disposal of the waste is the key to the effective management of biomedical waste in a workplace.

### DETAILS OF DIFFERENT TYPES OF WASTE AT HOLKAR SCIENCE COLLEGE

| S. NO. | TYPE OF WASTE                              | QUANTITY OF WASTE GENERATED          | METHODOLOGY OF DISPOSAL OF WASTE | REFUSE    | REDUCE | REUSE | RECYCLE | REPAIR | RE-GIFT | RECOVER | SUGGESTIONS                                | COLLEGE TYPES OF WASTE                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------|--------------------------------------------|--------------------------------------|----------------------------------|-----------|--------|-------|---------|--------|---------|---------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Solid Waste Management                     | 2000 kg per month                    | Microbial Decomposition          |           |        |       | Yes     |        |         |         |                                            | I. Kitchen Wastes<br>II. Wastes from construction sites.<br>III. liquid wastes (residential and eateries)<br>IV. sewage and Sludge<br>V. Biomedical waste<br>VI. Laboratory chemical wastes<br>VII. Plastic wastes<br>VIII. Cans and bottles<br>IX. Damaged or spoiled laboratory glassware<br>X. Unused tools and machinery including battery<br>XI. Papers including packaging materials<br>XII. Electronics waste<br>XIII. Garden leaves<br>XIV. Sweeping litters. |
| 2      | Municipal Solid Waste                      | Negligible Quantity                  |                                  |           |        |       |         |        |         |         |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 3      | Kitchen waste from canteen, Qtrs. & hostel | 40 kg per day                        |                                  |           |        | Yes   |         |        |         |         | For generation of Methane Gas              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 4      | Plastic waste                              | NA                                   |                                  |           |        |       |         |        |         |         |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 5      | Banning of single use plastic              | Completely banned from 1st July 2022 |                                  |           |        |       |         |        |         |         | Completely banned from 1st July 2022       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 6      | Construction & Demolition waste            | 4500 cubic meters                    |                                  | Landfills |        |       |         |        |         |         | Use such waste as aggregates               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 7      | E-waste Management                         |                                      |                                  |           | Yes    |       |         |        |         |         | Form 3, Annual return by 30th June         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 8      | Hazardous waste management                 | NA                                   |                                  |           |        |       |         |        |         |         | Form 4 on or before the 30th June          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 9      | Bio-medical waste                          | 28 kg per month                      |                                  |           | Yes    |       |         |        |         |         | Send to trenching ground after autoclaving |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 10     | Battery waste                              | NA                                   |                                  |           |        |       |         |        |         |         |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 11     | Wooden scrap                               | 12000 cubic feet                     |                                  | Yes       |        |       |         | Yes    |         |         | Renovated                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 12     | Ferrous Scrap                              | 5555 kg                              |                                  |           | Yes    |       |         |        |         |         | Sold and revenue generated                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 13     | Non-Ferrous Scrap                          | NA                                   |                                  |           |        |       |         |        |         |         |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 14     | Biodegradable waste                        | 1000 kg per month                    |                                  |           |        |       | Yes     |        |         |         | Vermicomposting                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 15     | Non-biodegradable waste                    | NA                                   |                                  |           |        |       |         |        |         |         |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 16     | Numbers of different waste                 | 3 kg                                 |                                  |           |        |       |         |        |         |         |                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

| S. NO. | TYPE OF WASTE                          | QUANTITY OF WASTE GENERATED | METHODOLOGY OF DISPOSAL OF WASTE | REFUSE | REDUCE | REUSE | RECYCLE | REPAIR | RE-GIFT | RECOVER | SUGGESTIONS                             | COLLEGE TYPES OF WASTE |
|--------|----------------------------------------|-----------------------------|----------------------------------|--------|--------|-------|---------|--------|---------|---------|-----------------------------------------|------------------------|
|        | bin                                    |                             |                                  |        |        |       |         |        |         |         |                                         |                        |
| 17     | Effluent Treatment Plant (ETP) details | 360 liters                  | LETP                             |        | Yes    |       |         |        |         |         | Damped in soak pit after neutralization |                        |

Note: N=No, Y=Yes, NA= Not Applicable

College is treating its effluent coming from laboratory before disposing it. They have installed Effluent Treatment Plant (ETP) in their campus. This is an excellent practice being adopted in very few colleges. Holkar science college has become the ambassador for taking lthis. Other college should take example from Holkar Science college & its awareness toward taking care for nature.



Converting waste to Bio-Fertilizer, Holkar Science College

# Energy Audit

## 9.0 ENERGY AUDIT

Energy is one of the major inputs for the economic development of any country. The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect. Also, it can be said as “the strategy of adjusting and optimizing energy, using system and procedure so as to reduce energy requirements per unit of output while holding constant or reducing total costs producing the output from these systems”. The energy audit is key to a systematic approach for decision-making in the area of energy management. It attempts to balance the total energy inputs with its use and serves to identify all the energy streams in a facility. The present policy of Government of India is to achieve Net Zero. All out efforts have been planned. Holkar Science College has done a lot towards green renewable energy. Mostly the campus is harvesting Solar energy. As discussed with the eminent professors, it was informed that sooner they are planning to harvest energy from wind energy also. **Holkar Science College is committed to achieve the goal of becoming net zero policy.**

### 9.1 Resource of Energy Audit

Energy resources utilized by all the departments, support services, and the administrative buildings of Holkar Science College, include Electricity, Solar Roof Top Systems, and Diesel Generators installed on the campus.

#### 9.1.1 Energy Audit Objective:

The main energy audit objective to reduce power consumption and save revenue of college. The objective of audit to maximizing saving energy and using best technology to save energy.

#### 9.1.2 Primary

- The first objective is to acquire, analyze data and find the necessary consumption pattern of the whole campus area.
- The second objective will be to calculate the wastage of energy pattern based on the results of the first objective.
- The final objective is to find and implement solutions that are acceptable and feasible in the most economical way.

#### 9.1.3 Secondary

**9.1.3.1** This would be the first exposure of college to this field hence experience gain would be vital (College themselves be able to identify the energy distribution).

**9.1.3.2** This project will follow many follow up projects and hence helps to gain technical and management exposure required for future energy projects.

**9.1.3.3** This will surely help create vital reduction hence will develop in overall achievement.

## 9.2 Source of Energy

As per last Energy audit report of 2021-2022 college total connected load was 333 kW and total sanctioned load was 145.57kW load.

## 9.3 Indirect Benefits of Energy Audit

Every time the Energy Audit is carried out it, there shall be analysis of Energy Conservation is an important function. Energy Auditors sharing their experience and knowledge with the Plant Personnel helps in fueling the innovative ideas for further action of reduction in Specific Power consumption (SPC). Any loose connections or heating of cables come to timely vision. For a next unbiased vision, a few points for Energy Conservation may be visible each time when perform the audit and this would help in achieving further saving. Inform any irregularities in Energy meter HT connections for rectification.

Till Last Audit Consumption was as below:

## 9.4 Details of Connected Load (kW) Till last year Audit

| Sr. No.                    | Connected Load                                                 | Load in kW |
|----------------------------|----------------------------------------------------------------|------------|
| 1                          | Indoor Lighting Load                                           | 64.66      |
| 2                          | Outdoor Lighting Load                                          | 3.1        |
| 3                          | Ceiling Fan, Exhaust Fan, Wall Fan Load                        | 74.88      |
| 4                          | Air Conditioning Load                                          | 31         |
|                            | Pumping System                                                 | 11.623     |
| 5                          | Printer, PC, Water Cooler, Refrigerator & Other lab equipments | 148.03     |
| Total Connected Load in kW |                                                                | 333        |

## 9.5 The Audit conducted on 15th & 16th December 2022 showed following changes

**Table 1: Different type of lighting fixture**

| Sr. No. | Location             | Location of Fixture | No. of Lighting Fixture | Power (Watts) | No. of Lumanarie | Total Power (Watts) |
|---------|----------------------|---------------------|-------------------------|---------------|------------------|---------------------|
| 1       | Chemistry Department | Dr.Anamika Jain     | 2                       | 36            | 1                | 72                  |
|         |                      |                     | 1                       | 40            | 2                | 80                  |
|         |                      | Back Cabin          | 1                       | 36            | 1                | 36                  |
|         |                      | Computer Cabin      | 2                       | 36            | 1                | 72                  |
|         |                      |                     | 1                       | 40            | 1                | 40                  |
|         |                      | Tea Room            | 3                       | 36            | 1                | 108                 |
|         |                      | Rest Room           | 1                       | 36            | 1                | 36                  |
|         |                      | Faculty Room 01     | 1                       | 36            | 1                | 36                  |
|         |                      |                     | 5                       | 40            | 1                | 200                 |
|         |                      | Faculty Room 02     | 3                       | 36            | 1                | 108                 |
|         |                      |                     | 3                       | 40            | 1                | 120                 |
|         |                      | Lab Ass. Cabin      | 1                       | 40            | 1                | 40                  |

| Sr. No. | Location                          | Location of Fixture    | No. of Lighting Fixture | Power (Watts) | No. of Lumanarie | Total Power (Watts) |
|---------|-----------------------------------|------------------------|-------------------------|---------------|------------------|---------------------|
|         |                                   | Chemistry Lab 01       | 18                      | 36            | 1                | 648                 |
|         |                                   |                        | 4                       | 40            | 1                | 160                 |
|         |                                   | Chemistry Lab 02       | 4                       | 36            | 1                | 144                 |
|         |                                   |                        | 8                       | 40            | 1                | 320                 |
|         |                                   | Chemistry Lab 03       | 10                      | 36            | 1                | 360                 |
|         |                                   |                        | 16                      | 40            | 1                | 640                 |
|         |                                   |                        | 3                       | 15            | 1                | 45                  |
|         |                                   |                        | 1                       | 24            | 1                | 24                  |
|         |                                   | Chemistry Lab 04       | 29                      | 40            | 1                | 1160                |
|         |                                   | Chemistry Lab 04       | 29                      | 40            | 1                | 1160                |
| 2       | Department of Seed & Horticulture | Dr.Kislaya Pancholi    | 2                       | 36            | 1                | 72                  |
|         |                                   | Class Room             | 6                       | 36            | 1                | 216                 |
|         |                                   |                        | 2                       | 9             | 1                | 18                  |
|         |                                   |                        | 2                       | 18            | 1                | 36                  |
|         |                                   |                        | 1                       | 85            | 1                | 85                  |
|         |                                   | Dept.of Horticulture.  | 2                       | 36            | 1                | 72                  |
|         |                                   | Staff Cabin 01         | 2                       | 36            | 1                | 72                  |
|         |                                   |                        | 1                       | 85            | 1                | 85                  |
|         |                                   | Staff Cabin 02         | 2                       | 36            | 1                | 72                  |
|         |                                   | Staff Cabin 02         | 2                       | 36            | 1                | 72                  |
| 3       | Department of Physics             | Dr.G.D.Gupta Cabin     | 3                       | 28            | 2                | 168                 |
|         |                                   | Solar Energy Building. | 10                      | 28            | 1                | 280                 |
|         |                                   |                        | 6                       | 28            | 2                | 336                 |
|         |                                   | Bathroom               | 4                       | 28            | 1                | 112                 |
|         |                                   | Account Office         | 3                       | 36            | 1                | 108                 |
|         |                                   |                        | 1                       | 40            | 1                | 40                  |
|         |                                   | Computer Lab           | 3                       | 36            | 1                | 108                 |
|         |                                   | Staff Room             | 1                       | 18            | 1                | 18                  |
|         |                                   |                        | 3                       | 36            | 1                | 108                 |
|         |                                   |                        | 5                       | 40            | 1                | 200                 |
|         |                                   | B.Sc. 1st Year         |                         |               |                  | 0                   |
|         |                                   | Room No-01             | 12                      | 36            | 1                | 432                 |
|         |                                   | Room No-02             | 10                      | 36            | 1                | 360                 |
|         |                                   |                        | 1                       | 18            | 1                | 18                  |
|         |                                   | B.Sc. 2nd Year Lab     | 9                       | 36            | 1                | 324                 |
|         |                                   |                        | 5                       | 40            | 1                | 200                 |
|         |                                   |                        | 4                       | 18            | 1                | 72                  |
|         |                                   | M.Sc. 1st Year Lab     | 2                       | 36            | 1                | 72                  |
|         |                                   |                        | 7                       | 18            | 1                | 126                 |
|         |                                   |                        | 1                       | 40            | 1                | 40                  |
|         |                                   | M.Sc. Finel Year       | 9                       | 36            | 1                | 324                 |
|         |                                   | Seminar Hall           | 4                       | 36            | 1                | 144                 |

| Sr. No. | Location                     | Location of Fixture          | No. of Lighting Fixture | Power (Watts) | No. of Lumanarie | Total Power (Watts) |
|---------|------------------------------|------------------------------|-------------------------|---------------|------------------|---------------------|
|         |                              |                              | 2                       | 40            | 1                | 80                  |
|         |                              | Gallery                      | 2                       | 36            | 1                | 72                  |
|         |                              | lab1 new block               | 28                      | 20            |                  |                     |
|         |                              | lab2                         | 28                      | 20            |                  |                     |
|         |                              | lab3                         | 28                      | 20            |                  |                     |
|         |                              | lab4                         | 28                      | 20            |                  |                     |
|         |                              | lab5                         | 28                      | 20            |                  |                     |
|         |                              | lab6                         | 28                      | 20            |                  |                     |
|         |                              | Varandah                     | 21                      | 20            | 1                | 40                  |
| 4       | Department of Bioinformatics | Hall                         | 4                       | 36            | 1                | 144                 |
|         |                              |                              | 2                       | 40            | 1                | 80                  |
|         |                              | Computer Lab                 | 4                       | 36            | 1                | 144                 |
|         |                              |                              | 1                       | 40            | 1                | 40                  |
| 5       | Department of Statistics     | Prof.M.Chaurang              | 6                       | 36            | 1                | 216                 |
|         |                              | Staff Room                   | 1                       | 36            | 1                | 36                  |
|         |                              |                              | 3                       | 40            | 1                | 120                 |
|         |                              |                              | 1                       | 9             | 1                | 9                   |
|         |                              | Computer Lab                 | 2                       | 36            | 1                | 72                  |
|         |                              | Lab                          | 5                       | 36            | 1                | 180                 |
|         |                              |                              | 7                       | 40            | 1                | 280                 |
|         |                              |                              | 3                       | 18            | 1                | 54                  |
|         |                              | Gallery & Store              | 2                       | 36            | 1                | 72                  |
| 6       | Clinic                       | Hall                         | 9                       | 40            | 1                | 360                 |
|         |                              |                              | 1                       | 36            | 1                | 36                  |
|         |                              |                              | 2                       | 12            | 1                | 24                  |
| 7       | PWD Building                 | Office                       | 2                       | 200           | 1                | 400                 |
|         |                              |                              | 4                       | 9             | 1                | 36                  |
|         |                              | Staff Room                   | 2                       | 5             | 1                | 10                  |
|         |                              |                              | 2                       | 15            | 1                | 30                  |
| 8       | IGNOU                        | Staff Room                   | 4                       | 9             | 1                | 36                  |
|         |                              |                              | 2                       | 36            | 1                | 72                  |
|         |                              |                              | 3                       | 40            | 1                | 120                 |
|         |                              |                              | 6                       | 9             | 1                | 54                  |
| 9       | Hostel                       | Office + Staff Room+ Canteen | 4                       | 12            | 1                | 48                  |
|         |                              |                              | 1                       | 18            | 1                | 18                  |
|         |                              |                              | 2                       | 15            | 1                | 30                  |
|         |                              | Ground Floor                 | 2                       | 12            | 1                | 24                  |
|         |                              |                              | 12                      | 9             | 1                | 108                 |
|         |                              |                              | 22                      | 12            | 1                | 264                 |



| Sr. No. | Location       | Location of Fixture  | No. of Lighting Fixture | Power (Watts) | No. of Lumanarie | Total Power (Watts) |
|---------|----------------|----------------------|-------------------------|---------------|------------------|---------------------|
|         |                | Class Room 6         | 1                       | 36            | 1                | 36                  |
|         |                |                      | 1                       | 85            | 1                | 85                  |
|         |                | English Lab          | 3                       | 40            | 1                | 120                 |
|         |                |                      | 3                       | 9             | 1                | 27                  |
|         |                | Crime Science Lab    | 5                       | 40            | 1                | 200                 |
|         |                |                      | 2                       | 18            | 1                | 36                  |
|         |                | Ladies Room          | 2                       | 40            | 1                | 80                  |
|         |                |                      | 1                       | 85            | 1                | 85                  |
|         |                |                      | 2                       | 9             | 1                | 18                  |
|         |                | Pharmaceuticals Che. | 4                       | 40            | 1                | 160                 |
|         |                | Class Room 3         | 4                       | 36            | 1                | 144                 |
|         |                |                      | 6                       | 40            | 1                | 240                 |
|         |                | Dept. of Hindi       | 1                       | 85            | 1                | 85                  |
|         |                |                      | 1                       | 48            | 1                | 48                  |
|         |                | Class Room 1         | 2                       | 40            | 1                | 80                  |
|         |                |                      | 2                       | 36            | 1                | 72                  |
|         |                |                      | 2                       | 85            | 1                | 170                 |
|         |                | Class Room 2         | 3                       | 40            | 1                | 120                 |
|         |                |                      | 1                       | 85            | 1                | 85                  |
|         |                |                      | 2                       | 9             | 1                | 18                  |
|         |                | Lab                  | 7                       | 40            | 1                | 280                 |
|         |                |                      | 2                       | 18            | 1                | 36                  |
|         |                | HOD Cabin            | 2                       | 9             | 1                | 18                  |
|         |                | Class Room4          | 9                       | 40            | 1                | 360                 |
|         |                |                      | 1                       | 85            | 1                | 85                  |
|         |                |                      | 1                       | 48            | 1                | 48                  |
|         |                |                      | 1                       | 36            | 1                | 36                  |
|         |                | Class Room 5         | 7                       | 40            | 1                | 280                 |
|         |                |                      | 1                       | 36            | 1                | 36                  |
|         |                | Corridor             | 1                       | 40            | 1                | 40                  |
|         |                |                      | 2                       | 36            | 1                | 72                  |
|         |                |                      | 1                       | 18            | 1                | 18                  |
| 13      | Block Building | Room No1             | 10                      | 36            | 1                | 360                 |
|         |                |                      | 1                       | 18            | 1                | 18                  |
|         |                |                      | 1                       | 9             | 1                | 9                   |
|         |                | Room No2             | 5                       | 36            | 1                | 180                 |
|         |                |                      | 2                       | 18            | 1                | 36                  |
|         |                |                      | 1                       | 85            | 1                | 85                  |
|         |                | Gents Toilet         | 1                       | 36            | 1                | 36                  |
|         |                | Room No3             | 3                       | 36            | 1                | 108                 |
|         |                |                      | 4                       | 18            | 1                | 72                  |

| Sr. No. | Location | Location of Fixture | No. of Lighting Fixture | Power (Watts) | No. of Lumanarie | Total Power (Watts) |
|---------|----------|---------------------|-------------------------|---------------|------------------|---------------------|
|         |          | Room No4            | 1                       | 40            | 1                | 40                  |
|         |          |                     | 6                       | 36            | 1                | 216                 |
|         |          |                     | 2                       | 18            | 1                | 36                  |
|         |          |                     | 2                       | 65            | 1                | 130                 |
|         |          | Room No5            | 2                       | 40            | 1                | 80                  |
|         |          |                     | 5                       | 36            | 1                | 180                 |
|         |          |                     | 3                       | 18            | 1                | 54                  |
|         |          | Girls Toilet        | 2                       | 36            | 1                | 72                  |
|         |          | Room No 6           | 4                       | 36            | 1                | 144                 |
|         |          |                     | 2                       | 18            | 1                | 36                  |
|         |          |                     | 2                       | 65            | 1                | 130                 |
|         |          | Room No7            | 8                       | 40            | 1                | 320                 |
|         |          |                     | 2                       | 65            | 1                | 130                 |
|         |          | Room No8            | 1                       | 40            | 1                | 40                  |
|         |          |                     | 8                       | 36            | 1                | 288                 |
|         |          |                     | 2                       | 65            | 1                | 130                 |
|         |          | Room No9            | 10                      | 36            | 1                | 360                 |
|         |          | Room No10           | 7                       | 36            | 1                | 252                 |
|         |          |                     | 3                       |               | 1                | 54                  |
|         |          | Waiting Room        | 10                      | 36            | 1                | 360                 |
|         |          | Staff Room          | 4                       | 36            | 1                | 144                 |
|         |          | Toilet              | 1                       | 100           | 1                | 100                 |
|         |          | HOD Cabin (English} | 4                       | 40            | 1                | 160                 |
|         |          |                     | 1                       | 70            | 1                | 70                  |
|         |          | Kitchen             | 1                       | 36            | 1                | 36                  |
|         |          | Corridor            | 11                      | 40            | 1                | 440                 |
|         |          |                     | 7                       | 9             | 1                | 63                  |
|         |          | NCC                 | 3                       | 36            | 1                | 108                 |
|         |          | Staff Room          | 6                       | 18            | 1                | 108                 |
|         |          | Class Room          | 4                       | 18            | 1                | 72                  |
|         |          | Room No11           | 8                       | 36            | 1                | 288                 |
|         |          | Room No12           | 12                      | 36            | 1                | 432                 |
|         |          | Room No13           | 12                      | 36            | 1                | 432                 |
|         |          | Ladies Toilet       | 2                       | 36            | 1                | 72                  |
|         |          | Room No14           | 12                      | 18            | 1                | 216                 |
|         |          | Room No15           | 12                      | 18            | 1                | 216                 |
|         |          | Room No16           | 8                       | 18            | 1                | 144                 |
|         |          | Room No17           | 12                      | 18            | 1                | 216                 |
|         |          | Room No18           | 12                      | 18            | 1                | 216                 |
|         |          | Room No19           | 12                      | 18            | 1                | 216                 |
|         |          | Room No20           | 8                       | 18            | 1                | 144                 |
|         |          | Room No 21          | 12                      | 36            | 1                | 432                 |

| Sr. No. | Location                    | Location of Fixture       | No. of Lighting Fixture | Power (Watts) | No. of Lumanarie | Total Power (Watts) |
|---------|-----------------------------|---------------------------|-------------------------|---------------|------------------|---------------------|
|         |                             | Room No 22                | 12                      | 36            | 1                | 432                 |
|         |                             | Toilet                    | 2                       | 36            | 1                | 72                  |
|         |                             | Room N1                   | 13                      | 40            | 80               | 720                 |
|         |                             | Room N2                   | 13                      | 40            | 80               | 720                 |
|         |                             | Room N3                   | 13                      | 40            | 80               | 720                 |
|         |                             | Room N4                   | 13                      | 40            | 80               | 720                 |
|         |                             | Room N5                   | 13                      | 40            | 80               | 720                 |
|         |                             | Room N6                   | 13                      | 40            | 80               | 720                 |
|         |                             | Staff Room                | 13                      | 40            | 80               | 720                 |
|         |                             | Corridor                  | 19                      | 36            | 1                | 684                 |
|         |                             |                           | 10                      | 18            | 1                | 180                 |
| 14      | Exam Controller Building    | Control Room              | 1                       | 18            | 1                | 18                  |
|         |                             | A/C Station               | 1                       | 36            | 1                | 36                  |
|         |                             |                           | 1                       | 65            | 1                | 65                  |
|         |                             | Semester Cell             | 2                       | 65            | 1                | 130                 |
|         |                             | IT Cell                   | 1                       | 65            | 1                | 65                  |
|         |                             |                           | 4                       | 36            | 1                | 144                 |
|         |                             |                           | 8                       | 48            | 1                | 384                 |
|         |                             | Controller of Examination | 1                       | 36            | 1                | 36                  |
|         |                             |                           | 4                       | 40            | 1                | 160                 |
|         |                             |                           | 1                       | 40            | 1                | 40                  |
|         |                             | Computer Room             | 1                       | 18            | 1                | 18                  |
|         |                             |                           | 1                       | 36            | 1                | 36                  |
|         |                             | Recording Room            | 1                       | 65            | 1                | 65                  |
|         |                             |                           | 1                       | 100           | 1                | 100                 |
|         |                             | Toilet                    | 1                       | 40            | 1                | 40                  |
|         |                             |                           | 1                       | 36            | 1                | 36                  |
|         |                             | Store Room                | 1                       | 65            | 1                | 65                  |
| 15      | Department of Biotechnology | HOD Cabin                 | 2                       | 40            | 1                | 80                  |
|         |                             |                           | 1                       | 36            | 1                | 36                  |
|         |                             | Corridor                  | 10                      | 40            | 1                | 400                 |
|         |                             |                           | 13                      | 40            | 1                | 520                 |
|         |                             | Lab 1                     | 3                       | 36            | 1                | 108                 |
|         |                             | PTC Lab                   | 1                       | 40            | 1                | 40                  |
|         |                             | Lab-2                     | 12                      | 40            | 1                | 480                 |
|         |                             | Computer Lab              | 3                       | 36            | 1                | 108                 |
|         |                             | Store Room                | 3                       | 40            | 1                | 120                 |
|         |                             |                           | 1                       | 85            | 1                | 85                  |
|         |                             | Staff Room                | 2                       | 40            | 1                | 80                  |

| Sr. No. | Location                   | Location of Fixture  | No. of Lighting Fixture | Power (Watts) | No. of Lumanarie | Total Power (Watts) |
|---------|----------------------------|----------------------|-------------------------|---------------|------------------|---------------------|
| 16      | Department of Zoology      | HOD Cabin            | 3                       | 36            | 1                | 108                 |
|         |                            |                      | 1                       | 65            | 1                | 65                  |
|         |                            | Staff Room           | 4                       | 40            | 1                | 160                 |
|         |                            |                      | 2                       | 9             | 1                | 18                  |
|         |                            | lab-1                | 27                      | 40            | 1                | 1080                |
|         |                            |                      | 3                       | 9             | 1                | 27                  |
|         |                            | Office Staff         | 1                       | 40            | 1                | 40                  |
|         |                            |                      | 1                       | 85            | 1                | 85                  |
|         |                            | Toilet               | 2                       | 100           | 1                | 200                 |
|         |                            | Corridor             | 1                       | 85            | 1                | 85                  |
| 17      | Department of Biochemistry | HOD Cabin            | 2                       | 18            | 1                | 36                  |
|         |                            | Research Lab         | 10                      | 18            | 1                | 180                 |
|         |                            | New Room             | 8                       | 40            | 0                | 0                   |
|         |                            | Kitchen              | 1                       | 40            | 1                | 40                  |
|         |                            | Office               | 2                       | 18            | 1                | 36                  |
|         |                            | BSc Lab              | 7                       | 36            | 1                | 252                 |
|         |                            | MSc Lab              | 8                       | 20            | 1                | 160                 |
|         |                            | Toilet               | 1                       | 40            | 1                | 40                  |
|         |                            |                      | 1                       | 36            | 1                | 36                  |
|         |                            | Corridor             | 12                      | 20            | 1                | 240                 |
|         |                            |                      | 12                      | 40            | 1                | 480                 |
| 18      | Department of Mathematics  | HOD Cabin            | 2                       | 40            | 1                | 80                  |
|         |                            |                      | 1                       | 36            | 1                | 36                  |
|         |                            | Office               | 2                       | 40            | 1                | 80                  |
|         |                            | Associate NCC Cabin  | 3                       | 36            | 1                | 108                 |
|         |                            | Kitchen              | 1                       | 40            | 1                | 40                  |
|         |                            | Corridor             | 3                       | 36            | 1                | 108                 |
|         |                            | Staff Room           | 4                       | 40            | 1                | 160                 |
|         |                            | Class Room 15        | 2                       | 36            | 1                | 72                  |
|         |                            |                      | 1                       | 40            | 1                | 40                  |
|         |                            |                      | 2                       | 18            | 1                | 36                  |
|         |                            | Class Room 16        | 4                       | 40            | 1                | 160                 |
| 19      | Department of Sport        | HOD Cabin            | 2                       | 36            | 1                | 72                  |
|         |                            |                      | 3                       | 18            | 1                | 54                  |
|         |                            | Staff Room           | 1                       | 40            | 1                | 40                  |
|         |                            | Electric Supply Room | 2                       | 40            | 1                | 80                  |
|         |                            | Placement Cell       | 1                       | 40            | 1                | 40                  |
|         |                            |                      | 1                       | 18            | 1                | 18                  |
|         |                            | Corridor             | 2                       | 40            | 1                | 80                  |

| Sr. No. | Location                  | Location of Fixture | No. of Lighting Fixture | Power (Watts) | No. of Lumanarie | Total Power (Watts) |
|---------|---------------------------|---------------------|-------------------------|---------------|------------------|---------------------|
| 20      | Yashwant Hall             | Hall                | 40                      | 40            | 1                | 1600                |
|         |                           |                     | 30                      | 36            | 1                | 1080                |
|         |                           |                     | 5                       | 15            | 1                | 75                  |
|         |                           |                     | 6                       | 500           | 1                | 3000                |
|         |                           |                     | 1                       | 1000          | 1                | 1000                |
|         |                           | Store Room          | 1                       | 40            | 1                | 40                  |
|         |                           | Corridor            | 3                       | 40            | 1                | 120                 |
| 21      | Department of Electronics | HOD cabin           | 6                       | 40            | 1                | 240                 |
|         |                           |                     | 2                       | 18            | 1                | 36                  |
|         |                           | Class Room          | 2                       | 40            | 1                | 80                  |
|         |                           | Lab                 | 7                       | 40            | 1                | 280                 |
| 22      | Department of Geology     | First Floor         |                         |               |                  |                     |
|         |                           | MSc Class 1         | 1                       | 18            | 1                | 18                  |
|         |                           | Class Room 2        | 2                       | 40            | 1                | 80                  |
|         |                           |                     | 1                       | 65            | 1                | 65                  |
|         |                           | Staff Room          | 3                       | 40            | 1                | 120                 |
|         |                           |                     | 2                       | 36            | 1                | 72                  |
|         |                           | Store Room          | 1                       | 40            | 1                | 40                  |
|         |                           | Class Room          | 3                       | 40            | 1                | 120                 |
|         |                           |                     | 3                       | 36            | 1                | 108                 |
|         |                           | Faculty Room        | 1                       | 18            | 1                | 18                  |
|         |                           | Ground Class Room   | 5                       | 36            | 1                | 180                 |
|         |                           | Staff Room          | 2                       | 36            | 1                | 72                  |
|         |                           | Museum              | 2                       | 40            | 1                | 80                  |
|         |                           |                     | 3                       | 36            | 1                | 108                 |
|         |                           | Room No-1           | 3                       | 36            | 1                | 108                 |
|         |                           | Room No-2           | 3                       | 36            | 1                | 108                 |
|         |                           | Room No-3           | 3                       | 36            | 1                | 108                 |
|         |                           | Corridor            | 1                       | 40            | 1                | 40                  |
|         |                           | Class Room 14       | 4                       | 40            | 1                | 160                 |
|         |                           | Class Room 23       | 5                       | 40            | 1                | 200                 |
|         |                           | Class Room 25       | 5                       | 40            | 1                | 200                 |
| 23      | Library                   | Office              | 6                       | 40            | 1                | 240                 |
|         |                           | Inside Study hall   | 49                      | 40            | 1                | 1960                |
|         |                           | Binding /Kitchen    | 1                       | 40            | 1                | 40                  |
|         |                           | Study Hall          | 22                      | 40            | 1                | 880                 |
|         |                           |                     | 3                       | 50            | 1                | 150                 |
|         |                           |                     | 3                       | 1000          | 1                | 3000                |
|         |                           | E-Library           | 3                       | 40            | 1                | 120                 |
|         |                           | Corridor            | 17                      | 40            | 1                | 680                 |

| Sr. No. | Location                       | Location of Fixture      | No. of Lighting Fixture | Power (Watts) | No. of Lumanarie | Total Power (Watts) |
|---------|--------------------------------|--------------------------|-------------------------|---------------|------------------|---------------------|
|         |                                | Girls Toilet             | 2                       | 40            | 1                | 80                  |
|         |                                | Boys Toilet              | 2                       | 40            | 1                | 80                  |
|         |                                | first floor              | 25                      | 40            |                  |                     |
|         |                                | Librarian                | 5                       | 36            | 1                | 180                 |
| 24      | Admin Building                 | Office                   | 3                       | 18            | 1                | 54                  |
|         |                                |                          | 2                       | 30            | 1                | 60                  |
|         |                                |                          | 1                       | 85            | 1                | 85                  |
|         |                                | Account Section          | 1                       | 30            | 1                | 30                  |
|         |                                |                          | 1                       | 36            | 1                | 36                  |
|         |                                | Corridor                 | 1                       | 18            | 1                | 18                  |
|         |                                |                          | 1                       | 9             | 1                | 9                   |
|         |                                | Data Store Room          | 2                       | 30            | 1                | 60                  |
|         |                                | Scholarship Cabin        | 1                       | 9             | 1                | 9                   |
|         |                                |                          | 2                       | 85            | 1                | 170                 |
|         |                                |                          | 2                       | 18            | 1                | 36                  |
|         |                                | Out Side Principal Cabin | 4                       | 40            | 1                | 160                 |
|         |                                |                          | 2                       | 30            | 1                | 60                  |
|         |                                |                          | 1                       | 9             | 1                | 9                   |
|         |                                | Principal Chamber        | 2                       | 36            | 1                | 72                  |
|         |                                |                          | 6                       | 18            | 1                | 108                 |
|         |                                |                          | 1                       | 85            | 1                | 85                  |
|         |                                |                          | 1                       | 200           | 1                | 200                 |
|         |                                | Kitchen                  | 1                       | 36            | 1                | 36                  |
|         |                                | Admis. Office            | 2                       | 30            | 1                | 60                  |
| 25      | Department of Computer Science | Office                   | 1                       | 40            | 1                | 40                  |
|         |                                | Lab-1                    | 2                       | 40            | 1                | 80                  |
|         |                                |                          | 3                       | 36            | 1                | 108                 |
|         |                                |                          | 2                       | 18            | 1                | 36                  |
|         |                                |                          | 1                       | 9             | 1                | 9                   |
|         |                                | Store Room               | 8                       | 40            | 1                | 320                 |
|         |                                | Corridor                 | 3                       | 40            | 1                | 120                 |
|         |                                |                          | 3                       | 36            | 1                | 108                 |
|         |                                | Lab-2                    | 2                       | 18            | 1                | 36                  |
|         |                                | E-Gallery                | 3                       | 40            | 2                | 240                 |
|         |                                |                          | 11                      | 36            | 1                | 396                 |
|         |                                |                          | 11                      | 18            | 2                | 396                 |
|         |                                | Lab-4                    | 2                       | 18            | 1                | 36                  |
|         |                                |                          | 3                       | 40            | 1                | 120                 |
|         |                                |                          | 9                       | 36            | 1                | 324                 |
|         |                                | Store Room               | 4                       | 40            | 1                | 160                 |

| Sr. No. | Location                   | Location of Fixture | No. of Lighting Fixture | Power (Watts) | No. of Lumanarie | Total Power (Watts) |
|---------|----------------------------|---------------------|-------------------------|---------------|------------------|---------------------|
|         |                            |                     | 2                       | 36            | 1                | 72                  |
|         |                            | MSc Room            | 6                       | 40            | 1                | 240                 |
|         |                            | Staff Cafeteria     | 4                       | 40            | 1                | 160                 |
|         |                            | Staff Room          | 2                       | 40            | 1                | 80                  |
|         |                            | HOD Cabin           | 1                       | 36            | 1                | 36                  |
|         |                            |                     | 3                       | 40            | 1                | 120                 |
|         |                            |                     | 2                       | 9             | 1                | 18                  |
|         |                            | Entrance            | 1                       | 40            | 1                | 40                  |
|         |                            | Lab1                | 25                      | 40            | 0                | 0                   |
|         |                            | Lab4                | 25                      | 40            | 0                | 0                   |
|         |                            | Class1              | 23                      | 40            | 0                | 0                   |
|         |                            | Class4              | 23                      | 40            | 0                | 0                   |
| 26      | Dr.W.V.Bhagwat Lab         | Front Lab           | 9                       | 28            | 1                | 252                 |
|         |                            |                     | 2                       | 18            | 1                | 36                  |
|         |                            |                     | 2                       | 40            | 1                | 80                  |
|         |                            | Class Room          | 4                       | 18            | 1                | 72                  |
|         |                            |                     | 3                       | 36            | 1                | 108                 |
|         |                            |                     | 2                       | 40            | 1                | 80                  |
|         |                            |                     | 2                       | 85            | 1                | 170                 |
|         |                            | Store Room          | 2                       | 40            | 1                | 80                  |
|         |                            | Gallery             | 2                       | 40            | 1                | 80                  |
|         |                            | Conference Hall     | 5                       | 18            | 1                | 90                  |
|         |                            |                     | 4                       | 40            | 1                | 160                 |
|         |                            |                     | 21                      | 40            | 2                | 1680                |
|         |                            | Staff Room          | 1                       | 18            | 1                | 18                  |
| 27      | Department of Microbiology | Flamming lab        | 3                       | 40            | 1                | 120                 |
|         |                            | New Room            | 6                       | 40            | 0                | 0                   |
|         |                            | Corridor            | 1                       | 9             | 1                | 9                   |
|         |                            | Loberk Koch Lab     | 2                       | 36            | 1                | 72                  |
|         |                            | Staff Room          | 2                       | 36            | 1                | 72                  |

| Sr. No. | Location  | Location of Fixture | No. of Lighting Fixture | Power (Watts) | No. of Lumanarie | Total Power (Watts) |
|---------|-----------|---------------------|-------------------------|---------------|------------------|---------------------|
| 28      | Fish Zone | Louis Pasture Lab   | 2                       | 85            | 1                | 170                 |
|         |           | Gallery             | 2                       | 40            | 1                | 80                  |
|         |           |                     | 1                       | 9             | 1                | 9                   |
|         |           | Class Room          | 10                      | 18            | 1                | 180                 |
|         |           |                     | 3                       | 9             | 1                | 27                  |
|         |           | Out Side light      | 1                       | 30            | 1                | 30                  |

**NOTE:**

Note: Holkar Science College Authorities are committed, to convert all CFL light sin LED lights

## 9.6 Analysis of Energy data

### 9.6.1 Indoor Lightings:

**Table 1: The Detail of Different Types of Indoor Lighting System**

| S. No.                                  | Power in (Watt) | Recommended LED in Watts | No. of Lighting Fixture | Total Power Load Before Changing Lights (Watts Per Day) | Total Power After changing Lights (Watts) per hour | Load Diffrence in Watts per hour | Saving Watts in % | Per Year Charge Electricity in Rs. | Price of LED Bulb | Total Price of LED Bulb | Electricity Rate in Rs. | Per Year Charges of Electricity after Changing Light | Net Gain Annually in Rs. |
|-----------------------------------------|-----------------|--------------------------|-------------------------|---------------------------------------------------------|----------------------------------------------------|----------------------------------|-------------------|------------------------------------|-------------------|-------------------------|-------------------------|------------------------------------------------------|--------------------------|
| 1                                       | 5               | Same                     | 2                       | 10                                                      | 10                                                 | 0                                | 0.00              | 221.88                             | 0                 | 0                       | 8.56                    | 221.88                                               | 0.00                     |
| 2                                       | 9               | Same                     | 100                     | 900                                                     | 900                                                | 0                                | 0.00              | 19968.77                           | 0                 | 0                       | 8.56                    | 19968.77                                             | 0.00                     |
| 3                                       | 12              | Same                     | 48                      | 576                                                     | 576                                                | 0                                | 0.00              | 12780.01                           | 0                 | 0                       | 8.56                    | 12780.01                                             | 0.00                     |
| 4                                       | 14              | Same                     | 3                       | 42                                                      | 42                                                 | 0                                | 0.00              | 931.88                             | 0                 | 0                       | 8.56                    | 931.88                                               | 0.00                     |
| 5                                       | 15              | Same                     | 12                      | 180                                                     | 180                                                | 0                                | 0.00              | 3993.75                            | 0                 | 0                       | 8.56                    | 3993.75                                              | 0.00                     |
| 6                                       | 18              | 15                       | 230                     | 4140                                                    | 3450                                               | 690                              | 16.67             | 91856.33                           | 65                | 14950                   | 8.56                    | 76546.94                                             | 15309.39                 |
| 7                                       | 20              | 15                       | 349                     | 6980                                                    | 5235                                               | 1745                             | 25.00             | 154868.89                          | 65                | 22685                   | 8.56                    | 116151.67                                            | 38717.22                 |
| 8                                       | 24              | 15                       | 1                       | 24                                                      | 15                                                 | 9                                | 37.50             | 532.50                             | 65                | 65                      | 8.56                    | 332.81                                               | 199.69                   |
| 9                                       | 28              | 15                       | 116                     | 3248                                                    | 1740                                               | 1508                             | 46.43             | 72065.06                           | 65                | 7540                    | 8.56                    | 38606.28                                             | 33458.78                 |
| 10                                      | 30              | 15                       | 10                      | 300                                                     | 150                                                | 150                              | 50.00             | 6656.26                            | 65                | 650                     | 8.56                    | 3328.13                                              | 3328.13                  |
| 11                                      | 36              | 15                       | 463                     | 16668                                                   | 6945                                               | 9723                             | 58.33             | 369821.58                          | 65                | 30095                   | 8.56                    | 154092.33                                            | 215729.26                |
| 12                                      | 40              | 15                       | 978                     | 39120                                                   | 14670                                              | 24450                            | 62.50             | 867975.78                          | 65                | 63570                   | 8.56                    | 325490.92                                            | 542484.86                |
| 13                                      | 48              | 15                       | 11                      | 528                                                     | 165                                                | 363                              | 68.75             | 11715.01                           | 65                | 715                     | 8.56                    | 3660.94                                              | 8054.07                  |
| 14                                      | 50              | Same                     | 3                       | 150                                                     | 150                                                | 0                                | 0.00              | 3328.13                            | 0                 | 0                       | 8.56                    | 3328.13                                              | 0.00                     |
| 15                                      | 65              | 50                       | 16                      | 1040                                                    | 800                                                | 240                              | 23.08             | 23075.02                           | 310               | 4960                    | 8.56                    | 17750.02                                             | 5325.00                  |
| 16                                      | 70              | 50                       | 1                       | 70                                                      | 50                                                 | 20                               | 28.57             | 1553.13                            | 310               | 310                     | 8.56                    | 1109.38                                              | 443.75                   |
| 17                                      | 85              | 50                       | 27                      | 2295                                                    | 1350                                               | 945                              | 41.18             | 50920.36                           | 310               | 8370                    | 8.56                    | 29953.15                                             | 20967.21                 |
| 18                                      | 100             | 50                       | 7                       | 700                                                     | 350                                                | 350                              | 50.00             | 15531.26                           | 310               | 2170                    | 8.56                    | 7765.63                                              | 7765.63                  |
| 19                                      | 200             | 100                      | 3                       | 600                                                     | 300                                                | 300                              | 50.00             | 13312.51                           | 499               | 1497                    | 8.56                    | 6656.26                                              | 6656.26                  |
| 20                                      | 500             | 200                      | 6                       | 3000                                                    | 1200                                               | 1800                             | 60.00             | 66562.56                           | 499               | 2994                    | 8.56                    | 26625.02                                             | 39937.54                 |
| 21                                      | 1000            | 200                      | 4                       | 4000                                                    | 800                                                | 3200                             | 80.00             | 88750.08                           | 499               | 1996                    | 8.56                    | 17750.02                                             | 71000.06                 |
|                                         |                 |                          | 2390                    | 84571                                                   | 39078                                              | 45493                            | 53.79             | 1876420.75                         | Rs.               | 162567                  |                         | 867043.91                                            | 1009376.85               |
| Cost of Purchase of Bulbs etc.          |                 |                          |                         |                                                         |                                                    |                                  |                   |                                    |                   |                         |                         | 162567.00                                            |                          |
| Purchase Cost Recovery Period in Months |                 |                          |                         |                                                         |                                                    |                                  |                   |                                    |                   |                         |                         | 1.93                                                 |                          |

## 9.6.2 Outdoor Lightings

**Table 2: The Detail of Different Types of Outdoor Lighting System**

| S.No.                                          | Power in (Watts) | Recommended LED in Watts | No. of Lighting Fixture | Total Power Load Before Changing Lights (Watts Per Day) | Total Power After changing Lights (Watts) per hour | Load Difference in Watts per hour | Saving in %  | Per Charge Electricity in Rs. | Year Price of LED Bulb in Rs. | Total Price of LED Bulb in Rs. | Electricity Rate | Per Year Charges of Electricity after Changing Light | Net Gain Annually in Rs. |
|------------------------------------------------|------------------|--------------------------|-------------------------|---------------------------------------------------------|----------------------------------------------------|-----------------------------------|--------------|-------------------------------|-------------------------------|--------------------------------|------------------|------------------------------------------------------|--------------------------|
| 1                                              | 12               | 12                       | 1                       | 12                                                      | 12                                                 | 0                                 | 0.00         | 443.75                        | 0                             | 0                              | 8.56             | 266.25                                               | 177.50                   |
| 2                                              | 18               | 15                       | 6                       | 108                                                     | 90                                                 | 18                                | 16.67        | 3993.75                       | 65                            | 390                            | 8.56             | 1996.88                                              | 1996.88                  |
| 3                                              | 24               | 15                       | 1                       | 24                                                      | 15                                                 | 9                                 | 37.50        | 887.50                        | 65                            | 65                             | 8.56             | 332.81                                               | 554.69                   |
| 4                                              | 30               | 15                       | 3                       | 90                                                      | 45                                                 | 45                                | 50.00        | 3328.13                       | 65                            | 195                            | 8.56             | 998.44                                               | 2329.69                  |
| 5                                              | 36               | 15                       | 2                       | 72                                                      | 30                                                 | 42                                | 58.33        | 2662.50                       | 65                            | 130                            | 8.56             | 665.63                                               | 1996.88                  |
| 6                                              | 40               | 15                       | 4                       | 160                                                     | 60                                                 | 100                               | 62.50        | 5916.67                       | 65                            | 260                            | 8.56             | 1331.25                                              | 4585.42                  |
| 7                                              | 50               | 50                       | 1                       | 50                                                      | 50                                                 | 0                                 | 0.00         | 1848.96                       | 310                           | 310                            | 8.56             | 1109.38                                              | 739.58                   |
| 8                                              | 85               | 50                       | 22                      | 1870                                                    | 1100                                               | 770                               | 41.18        | 69151.10                      | 310                           | 6820                           | 8.56             | 24406.27                                             | 44744.83                 |
| 9                                              | 500              | 100                      | 1                       | 500                                                     | 100                                                | 400                               | 80.00        | 18489.60                      | 499                           | 499                            | 8.56             | 2218.75                                              | 16270.85                 |
|                                                |                  |                          | <b>41</b>               | <b>2886</b>                                             | <b>1502</b>                                        | <b>1384</b>                       | <b>47.96</b> | <b>106721.97</b>              | <b>Rs.</b>                    | <b>8669</b>                    |                  | <b>33325.66</b>                                      | <b>73396.32</b>          |
| <b>Cost of Purchase of Bulbs etc.</b>          |                  |                          |                         |                                                         |                                                    |                                   |              |                               |                               |                                |                  |                                                      | <b>8669.00</b>           |
| <b>Purchase Cost Recovery Period in Months</b> |                  |                          |                         |                                                         |                                                    |                                   |              |                               |                               |                                |                  |                                                      | <b>1.42</b>              |

## 9.6.3 Fans:

**Table 3: The Detail of Different Types of FAN**

| S No.                                          | Power (Watts) | Recommended BLDC FAN in Watts | Number of FAN | Total Power Load Before Changing BLDC FAN (Watts Per Day) | Total Power After changing BLDC FAN (Watts) per hour | Difference in Watts | Saving in % | Per Charge Electricity in Rs. | Year Price of BLDC FAN | Total Price of BLDC FAN | Electricity Rate | Per Year charges of Electricity after changing BLDC FAN | Net Gain Annually in Rs. |
|------------------------------------------------|---------------|-------------------------------|---------------|-----------------------------------------------------------|------------------------------------------------------|---------------------|-------------|-------------------------------|------------------------|-------------------------|------------------|---------------------------------------------------------|--------------------------|
| 1                                              | 45            | 45                            | 60            | 2700                                                      | 2700                                                 | 0                   | 0.00        | 59906.30                      | 0                      | 0                       | 8.56             | 59906.30                                                | 0.00                     |
| 2                                              | 50            | 50                            | 50            | 2500                                                      | 2500                                                 | 0                   | 0.00        | 55468.80                      | 0                      | 0                       | 8.56             | 55468.80                                                | 0.00                     |
| 3                                              | 55            | 55                            | 4             | 220                                                       | 220                                                  | 0                   | 0.00        | 4881.25                       | 0                      | 0                       | 8.56             | 4881.25                                                 | 0.00                     |
| 4                                              | 60            | 60                            | 289           | 17340                                                     | 17340                                                | 0                   | 0.00        | 384731.60                     | 0                      | 0                       | 8.56             | 384731.60                                               | 0.00                     |
| 5                                              | 75            | 75                            | 6             | 450                                                       | 450                                                  | 0                   | 0.00        | 9984.38                       | 0                      | 0                       | 8.56             | 9984.38                                                 | 0.00                     |
| 6                                              | 80            | 80                            | 1001          | 80080                                                     | 80080                                                | 0                   | 0.00        | 1776776.60                    | 0                      | 0                       | 8.56             | 1776776.60                                              | 0.00                     |
| 7                                              | 100           | 35                            | 2             | 200                                                       | 70                                                   | 130                 | 65.00       | 4437.50                       | 3200                   | 6400                    | 8.56             | 1553.13                                                 | 2884.38                  |
| 8                                              | 120           | 35                            | 19            | 2280                                                      | 665                                                  | 1615                | 70.83       | 50587.55                      | 3200                   | 60800                   | 8.56             | 14754.70                                                | 35832.84                 |
| 9                                              | 150           | 35                            | 32            | 4800                                                      | 1120                                                 | 3680                | 76.67       | 106500.10                     | 3200                   | 102400                  | 8.56             | 24850.02                                                | 81650.07                 |
|                                                |               |                               | <b>1463</b>   | <b>110570</b>                                             | <b>105145</b>                                        | <b>5425</b>         | <b>4.91</b> | <b>2453274.09</b>             | <b>Rs.</b>             | <b>169600</b>           |                  | <b>2332906.79</b>                                       | <b>120367.30</b>         |
| <b>Cost of Purchase of BLDC FAN etc.</b>       |               |                               |               |                                                           |                                                      |                     |             |                               |                        |                         |                  |                                                         | <b>169600.00</b>         |
| <b>Purchase Cost Recovery Period in Months</b> |               |                               |               |                                                           |                                                      |                     |             |                               |                        |                         |                  |                                                         | <b>16.91</b>             |

## 9.6.4 Air Conditioners:

**Table 4: The Details of Different Type AC System**

| S.No | Power (Watts) | Recommended Star Inverter AC in Watts | Number of AC | Total Power Load Before Changing AC (Watts Per Day) | Total Power After Changing AC (Watts) per hour | Difference in Watts | Saving in % | Pay Per Year Charge Electricity in Rs. | Price of Hot & Cool Inverter AC | Total Price of AC (Hot & Cold Inverter AC) | Electricity Rate | Per Year Charges of Electricity after changing Inverter AC | Net Gain Annually in Rs. |
|------|---------------|---------------------------------------|--------------|-----------------------------------------------------|------------------------------------------------|---------------------|-------------|----------------------------------------|---------------------------------|--------------------------------------------|------------------|------------------------------------------------------------|--------------------------|
| 1    | 1425          | 1425                                  | 3            | 4275                                                | 4275                                           | 0                   | 0.00        | 94851.65                               | 0                               | 0                                          | 8.56             | 94851.65                                                   | 0.00                     |
| 2    | 1450          | 1450                                  | 2            | 2900                                                | 2900                                           | 0                   | 0.00        | 64343.81                               | 0                               | 0                                          | 8.56             | 64343.81                                                   | 0.00                     |
| 3    | 1452          | 1452                                  | 1            | 1452                                                | 1452                                           | 0                   | 0.00        | 32216.28                               | 0                               | 0                                          | 8.56             | 32216.28                                                   | 0.00                     |
| 4    | 1556          | 1556                                  | 3            | 4668                                                | 4668                                           | 0                   | 0.00        | 103571.34                              | 0                               | 0                                          | 8.56             | 103571.34                                                  | 0.00                     |
| 5    | 1650          | 1650                                  | 1            | 1650                                                | 1650                                           | 0                   | 0.00        | 36609.41                               | 0                               | 0                                          | 8.56             | 36609.41                                                   | 0.00                     |
| 6    | 1850          | 1500                                  | 2            | 3700                                                | 3000                                           | 700                 | 18.92       | 82093.82                               | 42000                           | 84000                                      | 8.56             | 66562.56                                                   | 15531.26                 |
| 7    | 1925          | 1925                                  | 10           | 19250                                               | 19250                                          | 0                   | 0.00        | 427109.76                              | 0                               | 0                                          | 8.56             | 427109.76                                                  | 0.00                     |
| 8    | 1950          | 1500                                  | 4            | 7800                                                | 6000                                           | 1800                | 23.08       | 173062.66                              | 42000                           | 168000                                     | 8.56             | 133125.12                                                  | 39937.54                 |
| 9    | 2375          | 2375                                  | 4            | 9500                                                | 9500                                           | 0                   | 0.00        | 210781.44                              | 0                               | 0                                          | 8.56             | 210781.44                                                  | 0.00                     |
|      |               |                                       | 30           | 55195                                               | 52695                                          | 2500                | 4.53        | 1224640.17                             |                                 | 252000                                     |                  | 1169171.37                                                 | 55468.80                 |
|      |               |                                       |              |                                                     |                                                |                     |             |                                        |                                 | Cost of Purchase of AC, etc.               |                  | 252000.00                                                  |                          |
|      |               |                                       |              |                                                     |                                                |                     |             |                                        |                                 | Purchase Cost Recovery Period in Months    |                  | 54.52                                                      |                          |

- Out of 30 Air conditioners, total 24 Star Rated Air Conditioner provided at Holkar Science College. The college is in phase of changing old normal air conditioner with new star rated ACs as and when there is requirement. Remaining 6 are also in process of replacement

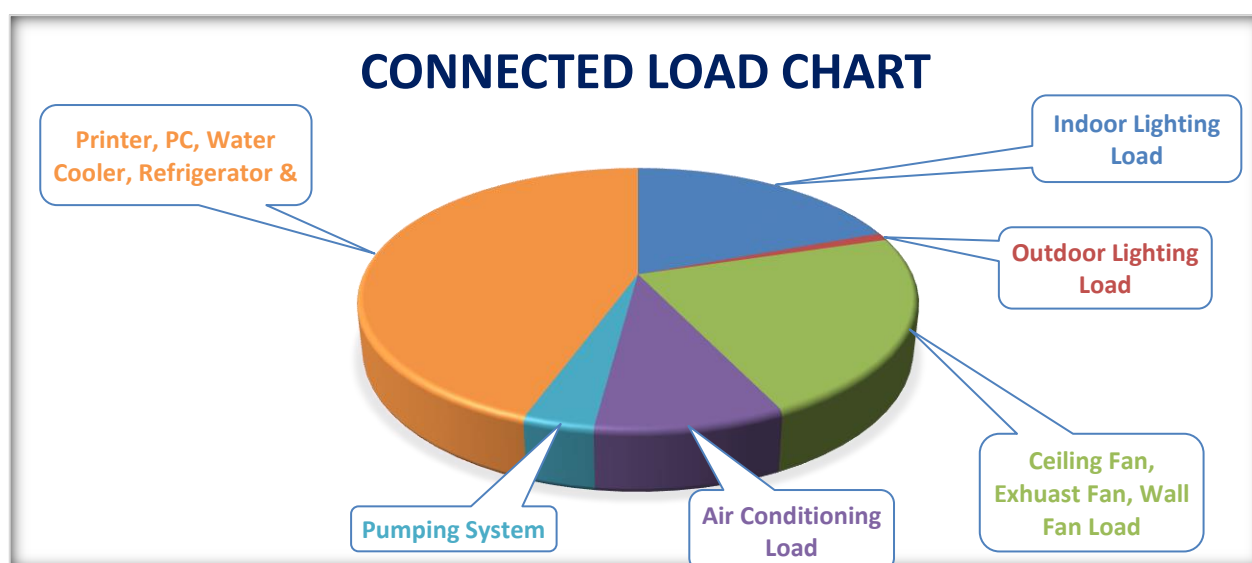
### 9.6.5 Submersibles:

| Location of Water Motor                 | Power in HP | Power Consumed Per Hours (Kw) | Working Hours Per Day | Number of Pump | Total Power Consumed (kW Per Day) | Total Power Consumption (kW Per Year) | Electricity Rate in Rs. | Per Year Electricity Charges in Rs. |
|-----------------------------------------|-------------|-------------------------------|-----------------------|----------------|-----------------------------------|---------------------------------------|-------------------------|-------------------------------------|
| Botany Building                         | 1           | 0.746                         | 3                     | 1              | 2.238                             | 26.86                                 | 8.56                    | 229.89                              |
| Chemistry Building                      | 1.5         | 1.119                         | 3                     | 1              | 3.357                             | 40.28                                 | 8.56                    | 344.83                              |
| Academic Building                       | 1.5         | 1.119                         | 3                     | 1              | 3.357                             | 40.28                                 | 8.56                    | 344.83                              |
| Main Office                             | 1           | 0.746                         | 3                     | 1              | 2.238                             | 26.86                                 | 8.56                    | 229.89                              |
| Library                                 | 1.5         | 1.119                         | 3                     | 1              | 3.357                             | 40.28                                 | 8.56                    | 344.83                              |
| Front of Zoology Department             | 1.5         | 1.119                         | 3                     | 1              | 3.357                             | 40.28                                 | 8.56                    | 344.83                              |
| of Zoology Department                   | 1           | 0.746                         | 3                     | 1              | 2.238                             | 26.86                                 | 8.56                    | 229.89                              |
| Hostel                                  | 2           | 1.492                         | 4                     | 1              | 5.968                             | 71.62                                 | 8.56                    | 613.03                              |
| Infront of 3 No. Gate                   | 3           | 2.238                         | 3                     | 1              | 6.714                             | 80.57                                 | 8.56                    | 689.66                              |
| Infront of Baba Garden                  | 1.5         | 1.119                         | 3                     | 1              | 3.357                             | 40.28                                 | 8.56                    | 344.83                              |
| <b>Per Year Power Consumption in kW</b> |             |                               |                       |                |                                   | <b>434.17</b>                         | <b>Total Rs.</b>        | <b>3716.51</b>                      |

### 9.6.6 Overall Analysis

| Sr. No.                    | Connected Load                                                            | Load in kW 2021 | Present Load kWh | Load after suggestion is implemented | Saving in Rupees |
|----------------------------|---------------------------------------------------------------------------|-----------------|------------------|--------------------------------------|------------------|
| 1                          | Indoor Lighting Load                                                      | 64.66           | 69.70            | 45.49                                | 605133.8         |
| 2                          | Outdoor Lighting Load                                                     | 3.1             | 3.10             | 1.50                                 | 39992.32         |
| 3                          | Ceiling Fan, Exhaust Fan, Wall Fan Load                                   | 74.88           | 110.57           | 105.15                               | 135474           |
| 4                          | Air Conditioning Load                                                     | 31              | 55.20            | 44.94                                | 256450.8         |
|                            | Pumping System                                                            | 11.623          | 11.62            | 11.62                                | 0                |
| 5                          | Printer, PC, Water Cooler, Refrigerator & Other lab equipments            | 148.03          | 148.03           | 148.03                               | 0                |
| 6                          | As per information provided 600 nos. of new computers have been purchased |                 | 120              | 120                                  | 0                |
| Total Connected Load in kW |                                                                           | 333             | 518.22           | 476.73                               | Rs 1037051       |

*Thus, from the above table it is seen that if we only change the indoor lightings and outdoor lightings, we can save Rs 6,40,000 approx. Annually. The return of cost of expenditure is also less than 2 months.*



As per the future policy, Holkar College is committed to convert all CFL into LED and they are already in a mode to purchase all electrical appliances star rated in future purchase. Hence forth all electrical appliances which are being purchased are all-star rated.

**For Analysis of Energy audit of the last year audit we had made certain assumptions:**

1. One month is of 30 days.
2. In one month, 24 days working and 6 leave.
3. On working days total 8 hours of working in which all lights are on.
4. On 6 holidays half of the lights are on.
5. Outdoor lightings 12 hours daily (6 PM to 6AM) for 365 days

### 9.7 Observation:

1. There is lot of scope of improvement at Holkar College in reduction of Energy.
2. If we only consider indoor **lights (bulbs & tubes)** and as per our recommendation if accepted:
  - ◆ Annual saving of **Rs. 6,05,133.80.**
  - ◆ If we purchase the fixture for lighting inside only will cost Rs. 1,17,262.
  - ◆ Hence the **purchase price return will be in 3 months.**

- ◆ Annual saving for the **first year will be Rs. 4,87,871.80**
  - ◆ After that **annual recurring benefit of Rs. 6,05,133.80** will be saved by college annually.
3. If recommendation of replacing outdoor lightings is accepted by college authorities, then:
    - ◆ Annual Saving is Rs. **39,992.32/-**
    - ◆ Cost of purchase is Rs. 8,669/-
    - ◆ Cost of purchase recovery period is 2. Months
    - ◆ First year profit will of Rs. **31,323.32**
    - ◆ After first year annual savings of Rs. **39,992.32/**
  4. If recommendation regarding fans 100 watts & above (Total Fans 74 numbers of fans) to replace with BLDC fans is accepted by College administration, then:
    - ◆ Annual Savings Rs. **1,35,474/-**
    - ◆ Cost of purchase of BLDC fans is Rs. 2,36,800/-
    - ◆ Return of cost of purchase is 22 months.
    - ◆ So after 2 years net Annual profit will be Rs. 2,36,800/-
    - ◆ This purchase can be split in 2 years as per administration's decision.
  5. Total No. Air Conditioner has been given as 30. But no data of blowers used during winter season has been provided. Out of total 30 Ac we suggest replacing 6 AC (with hot & cold facility). If our recommendation of replacement of 12 AC is accepted, then:
    - ◆ Annual saving will be Rs. **2,56,450.8**
    - ◆ Cost of purchase of Hot & cold AC is Rs. 2,52,000/-
    - ◆ Return of cost of purchase is **11 months**
    - ◆ So first year profit will be Rs. NIL
    - ◆ Afterwards annual profit will be Rs. **2,56,450.00/-**
  6. More solar plant for generation of renewable energy can be installed on various buildings.
  7. Normal fans can be replaced by BLDC fans and cost of return is within leases then 2 years.
  8. Street lights consuming huge energy can be replaced with normal LED light which are energy efficient as well as cost saving. Management can plan according to budget & sanctioning powers.
  9. By estimating the quantity of water and time of operation of pump & motor, we could reduce the consumption of electricity as well.

### 9.7.1 Lighting system

Lighting is an essential service in all industries, Universities, Hospitals, Malls, etc. Innovation and continuous improvement in the field of lighting, have given rise to tremendous energy-saving opportunities in this area. Lighting is an area, which provides some major scope to achieve energy efficiency at the design stage, by incorporation of modern energy-efficient lamps, luminaries, and gears, apart from good operational practices.

## ***Basic Terms in Lighting System and Features:***

### **9.7.2 Lamps**

Lamp is equipment, which produces light. The most used lamps are

Described briefly as follows:

### **9.7.3 Incandescent lamps**

Incandescent lamps produce light by means of a filament heated to incandescence by the flow of electric current through it. The principal parts of an incandescent lamp, also known as GLS (General Lighting Service) lamp include the filament, the bulb, the filling, and the cap.

### **9.7.4 Reflector lamps**

Reflector lamps are basically incandescent, provided with a high-quality internal mirror, which follows exactly the parabolic shape of the lamp. The reflector is resistant to corrosion, thus making the lamp maintenance free and output efficient.

### **9.7.5 Gas discharge lamps**

The light from a gas discharge lamp is produced by the excitation of gas contained in either a tubular or elliptical outer bulb. The most used discharge lamps are as follows:

- Fluorescent tube lamps (FTL)
- Compact Fluorescent Lamps (CFL)
- Mercury Vapor Lamps
- Sodium Vapor Lamps
- Metal Halide Lamps

## **10 Energy Conservation and Renewable energy**

### **10.1 Renewable Energy**

Computer Science department of Holkar Science College was checked. This department is generating 5kW of solar energy. Total load of is 25 kW solar energy is being generated by the college through solar plant installed on the roof top. It also has capacity to transfer to the grid as per need and necessity. Further the college is in process of converting wind energy into next source of renewable energy which will also cater further need of the department. Several other departments are going to provide roof top solar panels

### **10.2 Renewable Energy (Solar) Analysis:**

| <b>Details of Renewable Energy (Solar) at Holkar Science College, Indore</b> |                                        |                                                  |                                                   |                                |                                 |
|------------------------------------------------------------------------------|----------------------------------------|--------------------------------------------------|---------------------------------------------------|--------------------------------|---------------------------------|
| <b>Department Name</b>                                                       | <b>Power Genrating in kW Per Hours</b> | <b>Solar Panel Power Genrating in kW Per Day</b> | <b>Solar Panel Power Genrating in kW Per Year</b> | <b>Electricity Rate in Rs.</b> | <b>Net Gain Annually in Rs.</b> |
| New Exam Department                                                          | 5                                      | 40                                               | 14600                                             | 8.56                           | 124976                          |
| New Physics Lab                                                              | 5                                      | 40                                               | 14600                                             | 8.56                           | 124976                          |
| New Computer Block                                                           | 5                                      | 40                                               | 14600                                             | 8.56                           | 124976                          |

|                                   |           |            |              |               |               |
|-----------------------------------|-----------|------------|--------------|---------------|---------------|
| Administrative Building           | 5         | 40         | 14600        | 8.56          | 124976        |
| Academic Block                    | 5         | 40         | 14600        | 8.56          | 124976        |
| <b>Total Power Generate in kW</b> | <b>25</b> | <b>200</b> | <b>73000</b> | <b>624880</b> | <b>624880</b> |

Holkar Science college, Indore has taken a big Leap by making 25kW solar energy & thus saving conventional energy by 73000 kW annually with annual saving of Rs. 6,24,880/- also.

### 10.3 Exemplary Reduce Power Consumption in Holkar Science College

During last 1-year Holkar College has achieved 25 kW of renewable Energy through solar power. This has reduced the electric consumption through power grid by 25 kW thus having a net saving of Rs. 6.24 Lakhs Annually. College administration is planning to install solar panel on other building also.

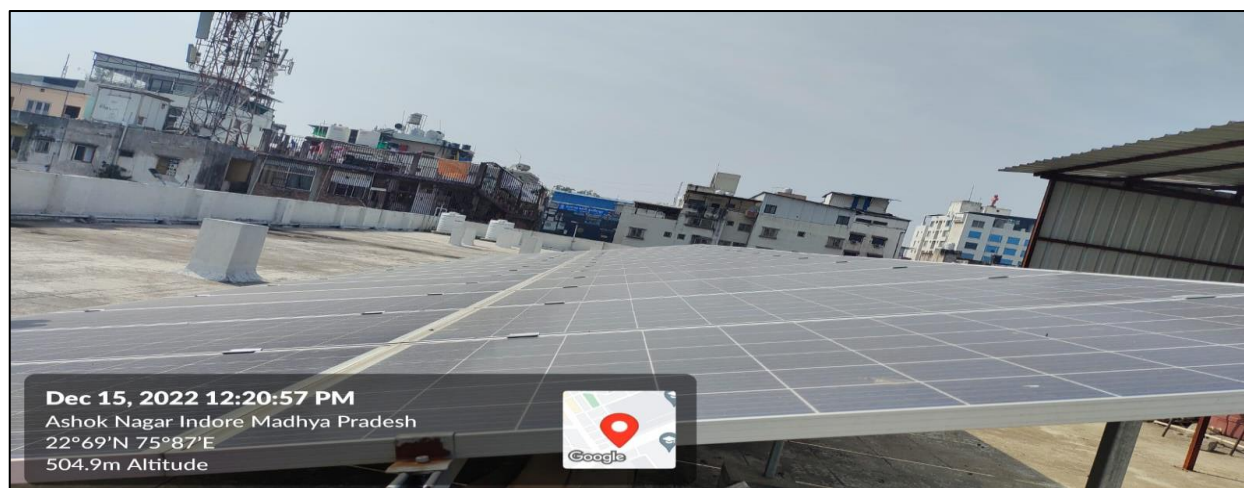


Figure1: Renewable Energy photograph of New Building Block

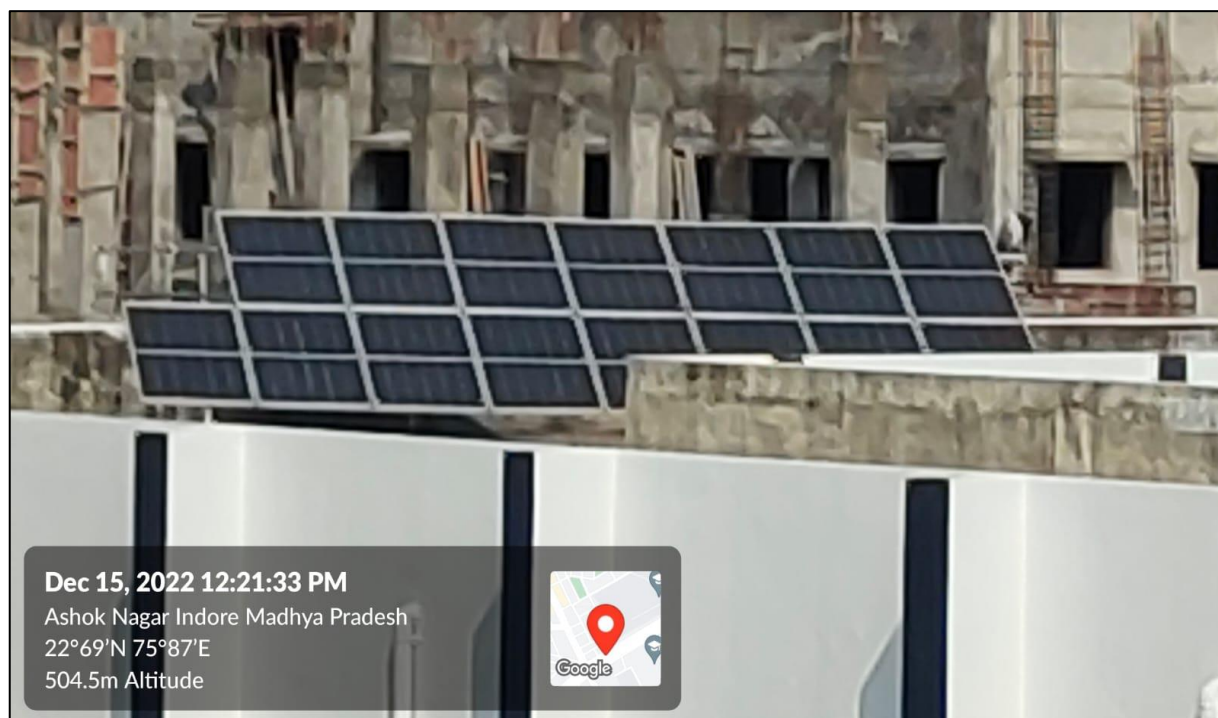
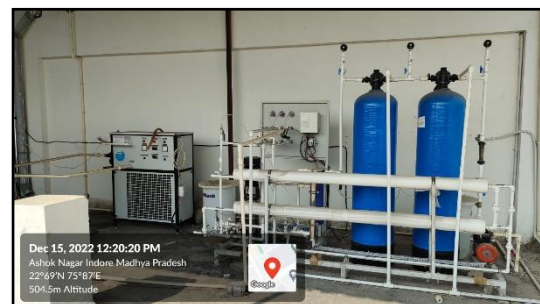


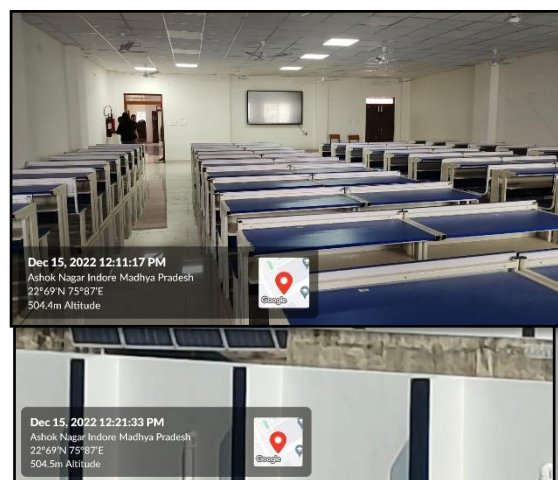
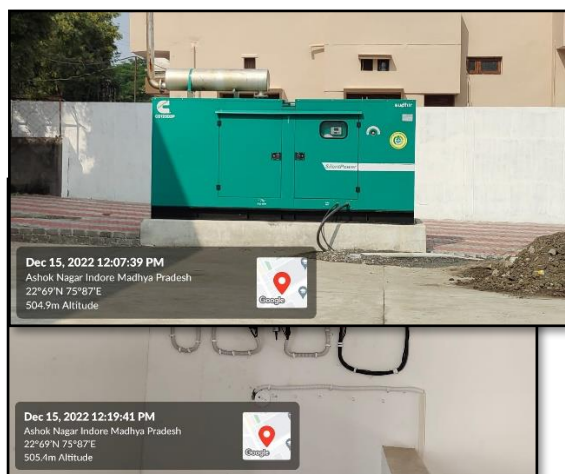
Figure2: RENEWABLE ENERGY PHOTOGRAPH OF DEPARTMENT OF PHYSICS



Figure3: RENEWABLE ENERGY PHOTOGRAPH OF DEPARTMENT OF COMPUTER SCIENCE



## Renewable Energy and water filtration plant on the roof top of Computer Science Department



### 10.3.1 Energy Management Strategy

Energy Management should be seen as a continuous process. Strategies should be reviewed annually and revised as necessary. The key activities suggested have been outlined below:

### 10.3.2 College Corporate Approach

The starting point in energy management is to identify a strategic corporate approach to energy management. Clear accountability for energy usage needs to be established, appropriate financial and staffing resources must be allocated, and reporting procedures initiated. An energy management program requires commitment from the whole organization to be successful. A record of Energy consumption must be kept and monitored on regular basis, to optimize the Energy consumption. For this, various meters may have to be installed.

#### 10.3.2.1 Designate an energy manager

An Energy Manager must be identified, and time bound responsibility must be given to him in getting implemented the findings of the Energy Audit points, which the Plant Establishment has planned to implement.

#### 10.3.2.2 Setup an energy monitoring and reporting system

Successful energy management requires the establishment of a system to collect/analyses and report the energy costs and consumption pattern. This will enable an overview of energy use and its related costs, as well as facilitating the identification of savings that might 'otherwise not be detected. The system needs to record both historical and ongoing energy use, as well as cost information from billing data, and capable of producing

summary reports on a regular basis. This information will provide how trends can be analyzed and reviewed for corrective measures.

#### *10.4 Implement a staff awareness and Training program*

A key ingredient to the success of an energy management program is maintaining a high level of awareness among staff. This can be achieved in several ways, including formal training, newsletters, posters and publications. It is important to communicate program plans and case studies that demonstrate savings, and to report results at least at 12-month intervals. Staff may need training from specialists on energy saving practices and equipment.

# Green Campus Audit

## 11 BIODIVERSITY AUDIT

The Biodiversity Audit Approach is an innovative, landscape-scale and evidence-based approach to delivery of biodiversity. It provides a working example of the implementation of an integrated approach to biodiversity delivery in a region. A key element has been the development of an evidence-based approach to understanding the requirements of priority species and providing guidelines for their conservation. Ecological requirements of priority species for conservation have been collated, and synthesized, integrating across numerous individual priority species to produce management guidance for multi-species assemblages. The approach: Collates and examines available evidence to understand what species are present. Objectively defines the suite of conservation priority species. Assess the recent or status of priority species. A key objective of the approach is to provide land managers and conservation advisers with guidance on how to enhance and sustain the important biodiversity. Effective management is best achieved by providing prescriptions based on sound evidence. The novel approach taken is to identify multi-species assemblages and associated flagship invertebrate and plant species, requiring similar ecological processes and conditions ('guilds'). This has the aim of integrating prescriptions for multiple species into habitat-based approaches, but through an evidence-based approach rooted in an understanding of the requirements of individual species.

This includes the plants, greenery, and sustainability of the campus to ensure that the buildings conform to green standards. This also helps in ensuring that the Environmental Policy is enacted, enforced, and reviewed using various environmental awareness programs.

### 11.1 BIODIVERSITY

To keep the greenery on the campus, the college regularly maintains the gardens which are looked after by concerned staff under the guidance of higher authorities of the college. Activities organized to create greenery and its conservation at the college campus is as follows-

- Plantation of diversified species, Uses of medicinal plants, Identification of plants species.
- Awareness of carbon consumption and carbon footprint program.

To create a green cover, Eco-friendly atmosphere, and pure oxygen at the college campus, a plantation program is organized every year with active participation from the college community and visitors. A committee has been formed as the Campus Horticulture Committee to keep the greeneries in the college campus. All gardens are regularly maintained and looked after by the Horticulture Section under the guidance of committee members. Various departmental activities are being carried out every year such as: -

- Plantations and other Landscaping Activities
- Maintenance of Gardens and Landscape
- Maintenance of Plantations

The horticultural activities for landscaping and beautification of Holkar Science College are

headed by a full-fledged Director who has his own team. There were transformation and redeemed of certain natural vegetation patches for requisite infrastructure development to facilitate the emerging needs for the growth of the college. However, spaces for academic, administrative and recreational areas are delineated in harmony with the landscape to ensure an eco-friendly campus. The Horticulture section headed by Director, Horticulture and gardening unit is posted in the college is looking after althea plantation and other landscaping activities within the College campus under the guidance of a by Director, Horticulture, and gardening unit. By Director, Horticulture and gardening unit has under him a team of dedicated staff who are only dedicated to horticulture and Gardening work & develops strategies for smooth execution of plantation, maintenance and overall protection of the landscape. Therefore, the greenery of a large area in the campus is well maintained besides keeping remnants of the natural vegetation patches undisturbed. There are block plantations, plantations along the roads side, garden space of departmental building premises, and along the residential compounds, while several tree species regenerated naturally and there are plants that cover the whole natural and scrapes. Several trees and plants are carefully selected for the plantation to provide shelter for birds and to provide a shaded walkway. Massive plantations and different landscaping beautification activities have already been carried out in different parts of the college campus.

### **11.2 PLANTATIONS**

Holkar college is in continuous process of planting trees of importance, medicinal values & fruit bearing. Holkar Science College on various national and international events/occasions with active participation from college communities and guests. This program helps in encouraging an eco-friendly environment that provides pure oxygen within the institute and awareness among villagers. The plantation program includes various types of indigenous species of ornamental and medicinal wild plant species. The plants have medicinal value, which faculty members of the Horticulture department, Botany department with the help of NSS students to identify with scientific names and give information about medicinal uses of the plants.



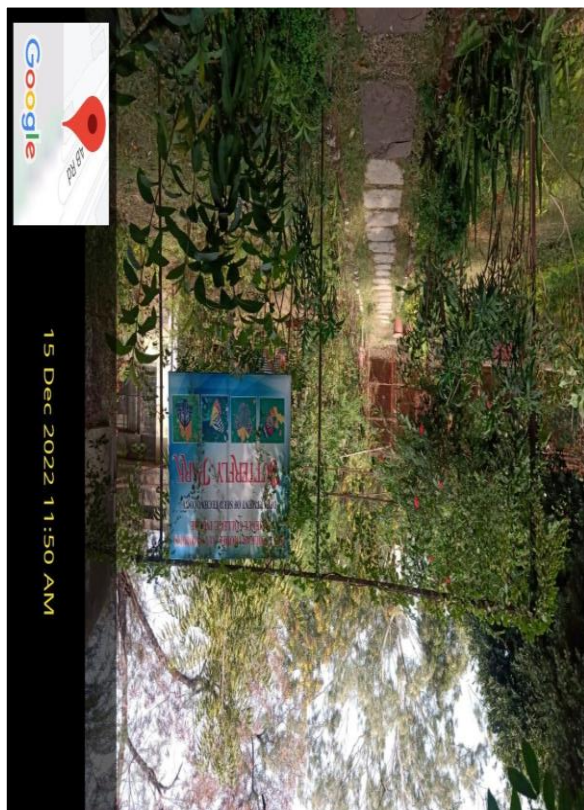
### 11.3 LANDSCAPING AND GARDENING ACTIVITIES

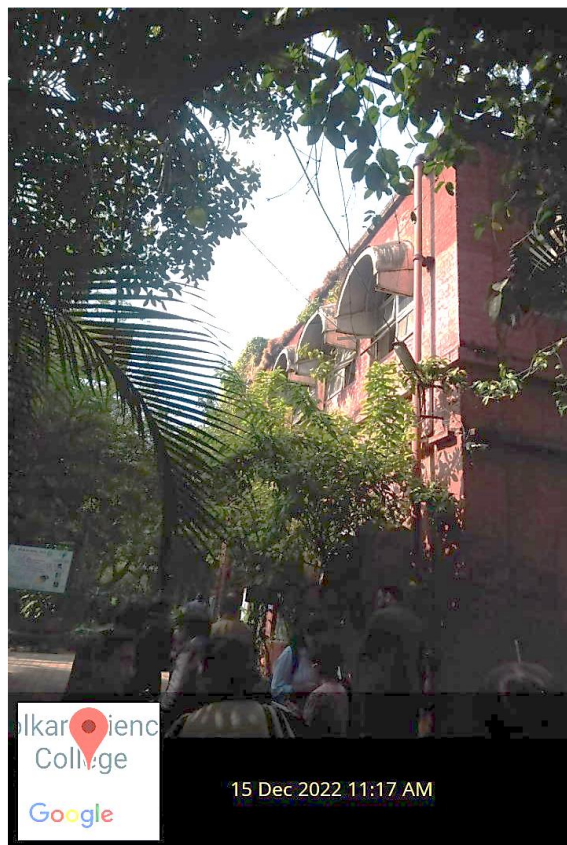
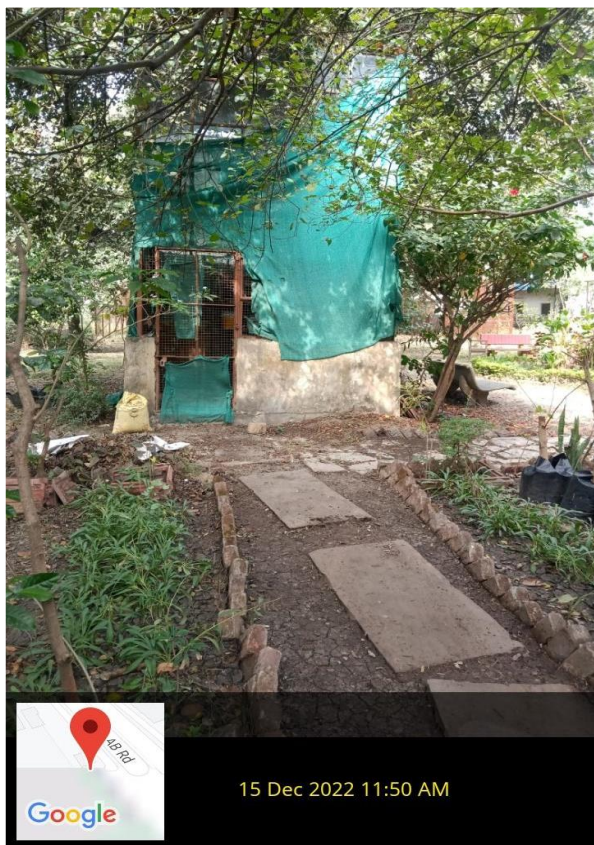
In addition, to carry out different plantation programs, efforts were also made by the Horticulture Section, Holkar Science College for beautification of different parts of the college campus by the development of flower gardens and other landscaping activities such as the development of lawns, hedges, ornamental and avenue plantations, etc. From July 2012 to March 2021, landscaping and gardening work in most of the prime locations of the college campus like the front side of the Entrance gate, different Administrative and Academic buildings, in front of Indian Coffee House, Central Library, Horticulture & Botany Department, and other amenity centers have been completed. Several green areas have also been developed within the college campus. Moreover, plantation of different types of medicinal plants on the existing area of different locations of the college campus has also been done for

further beautification of the landscape.

#### **11.4 MAINTENANCE OF GARDENS AND LANDSCAPE**

In addition to new plantation drives and landscaping/beautification activities, all essential maintenance work (like lawn, hedge, existing plants /shrubs, growing of seasonal flowers) for previously developed flower and other gardens, as well as other locations of the college campus, is done regularly under the supervision of Horticulture Section. College has a separate Horticulture department.





### 11.5 MAINTENANCE OF PLANTATIONS

Apart from the maintenance of gardens, all previously planted trees (like roadside and other plantations) in different locations of the college campus are regularly nurtured by cleaning, fertilization, watering, etc.



## 11.6 HOUSE PLANTS

House plants do not just look good – they can make us feel good, too. Studies have shown that house plants-

- Boost our mood, productivity, concentration, and creativity.
- Reduce our stress, fatigue, sore throats, and colds.
- Help clean indoor air by absorbing toxins, increasing humidity & producing oxygen.
- Add life to sterile space, give privacy and reduce noise levels.

Considering the different benefits of houseplants, currently, about 950 House plant pots are replaced in the interior space of different administrative offices and Academic buildings, Guest House, Library, Auditorium and other amenity centers for beautification, greenery, and purifying the air. Essential maintenance works of these houseplants are carried out regularly under the supervision of the Horticulture department, Holkar Science College.



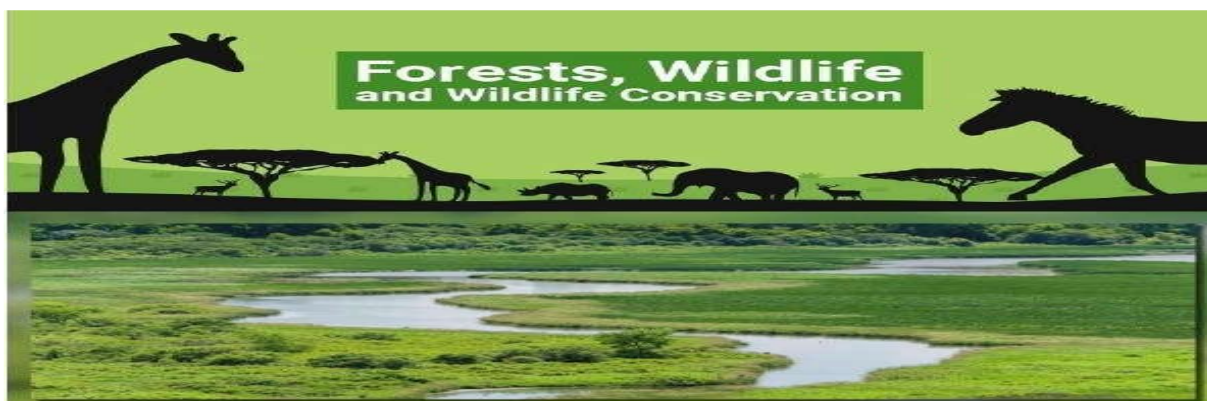
### 11.7 Campus Involvement

For sustainable use of resources and for the mission of “GO-GREEN” it is necessary that the students, faculty, and administration welcome it. Holkar Science College is an environment that invites opportunities to better its community through campus organizations. The green initiative started on the campus many years ago. The college students are actively participating and solely concerned with the environment. These students, under the guidance of faculties strive to create an environmentally friendly campus. Their purpose is to create awareness and eventually act on that awareness. college is also actively conducting environmental awareness programs on campus regularly.

### 11.8 Environmental Conservation Program

College is very active in the practical education of the students regarding environmental conservation. The college has arranged visits to their faculties to the Wildlife Institute of India (WII), Botanical Garden, Sanctuaries, Zoological Park sacred groves in order to educate their students. The college also took their students to different National Parks to educate the students about in situ Conservation of Wildlife. Mushroom cultivation is also being done in college campus.

### 11.9 Protection of biodiversity of Flora Fauna associated with College



### 11.10 BIODIVERSITY OF FLORA FAUNA ASSOCIATED WITH IN COLLEGE CAMPUS

#### 11.10.1 INTRODUCTION

Biodiversity is one measure of the health of biological systems. Life on earth today consists of many millions of distinct biological species. Biodiversity is not consistent across the earth. It is consistently rich in the tropics, and it is less rich in Polar Regions where conditions support much less biomass. A complex relationship exists among the different diversity levels. Identifying one level of diversity in a group of organisms does not necessarily indicate its relationship with other types of diversities. Rapid environmental changes typically cause extinctions. Most species that have existed on earth are now extinct. The period since the emergence of humans has displayed an ongoing reduction in biodiversity. Named the Holocene extinction, the reduction is caused primarily by human impacts, particularly the destruction of plant and animal habitats.



### 11.10.2 Need for biodiversity conservation.

Conservation is the protection, preservation, management, or restoration of wildlife and natural resources such as forests and water. Through the conservation of biodiversity, the survival of many species and habitats which are threatened due to human activities can be ensured. Other reasons for conserving biodiversity include securing valuable Natural Resources for future generations and protecting the wellbeing of ecosystem functions. Plant genetic resources are the product of natural evolution and human intervention. In-situ biodiversity conservation includes the conservation of habitats, species, and ecosystems where they naturally occur. The conservation of elements of biodiversity out of the context of their natural habitats is referred to as ex-situ biodiversity conservation.

### Fauna Survey

The term fauna represents all the animal species found in a particular region at a particular time. These are the naturally occurring animal species of the area. It can be measured by taking a number of quadrats and recording presence/absence in each, or in each of the subdivisions of the quadrat. Fauna use many different parts of the environment. Some are ground-dwellers, others arboreal and some live underground or in rock crevices.

In accordance to paper published by Mr. V. K Sharma & accepted, A total of 58 species of spiders belonging to 38 genera under 17 families viz., Araneidae, Clubionidae, Erisidae, Gnaphosidae, Hersillidae, Lycosidae, Mitrogidae, Oxyopidae, Pisuridae, Philodromidae, Salticidae, Scytodidae, Sparssidae, Therididae, Thomisidae, Tetragnathidae, Uloboridae, were recorded. Among these families most dominated family was Araneidae. This Family represented by 8 genera and 23 species. The second largest family was Salticidae, represented by 10 genera & 13 species. Abundance of Araneidae may be due to greater availability of prey due to better humidity and occurrence of high number of Salticidae is because it is cosmopolitan present everywhere in abundance. The survey result shows that the fauna of Holkar Science College is rich inspider diversity.

# DIVERSITY OF SPIDERS HOLKAR SCIENCE COLLEGE, INDORE (M. P.), INDIA

V. K. SHARMA

Department of Zoology, Government Holkar Science College, Indore, Madhya Pradesh, India

## ABSTRACT

A total of 58 species of spiders belonging to 38 genera under 17 families viz., Araneidae, Clubionidae, Eresidae, Gnaphosidae, Hersilliidae, Lycosidae, Miturgidae, Oxyopidae, Pisuridae, Philodromidae, Salticidae, Scytodidae, Sparassidae, Theridiidae, Thomisidae, Tetragnathidae, Uloboridae, were recorded. Among these families most dominated family was Araneidae. This Family represented by 8 genera and 23 species. The second largest family was Salticidae, represented by 10 genera & 13 species. Abundance of Araneidae may be due to greater availability of prey due to better humidity and occurrence of high number of Salticidae is because it is cosmopolitan present everywhere in abundance. The survey result shows that the fauna of Holkar Science College is rich in spider diversity.

## DISCUSSIONS AND CONCLUSIONS

The spider's of Holkar College, Indore (MP) is rich in number and types of species represented by 58 species belonging to 37 genera under 17 families. 23 species belonging to Araneidae family followed by 13 species belonging to Salticidae family, 4 species belonging to Theridiidae family, 2 species each of family Thomisidae, Oxyopidae, Lycosidae and one species each of families Clubionidae, Eresidae, Gnaphosidae, Hersilliidae, Miturgidae, Sparassidae, Tetragnathidae, Philodromidae and Uloboridae.

### 11.11 Pilot fauna survey

Animal species present around each of the building locations were assessed. Places such as in and around the college vicinity, in the soil and on the vegetation around the college were checked and noted. Some of the fauna species which could not be identified on the field were collected for identification in the Zoology laboratory of the college.



## 11.12 Questionnaire based fauna survey:

An assessment of animal species commonly cited around the study college area by pupils and workers of the college was also conducted through a structured interview schedule (questionnaire). The respondents were allowed to express the names of the animal species in their local language (Hindi or English).

**Table 1: List of Avian fauna recorded at the Govt. Holkar Science College Campus, Indore.**

| S. No. | Order/Family/Common Name                                             | Scientific Name                  | RS | IUCN Status |
|--------|----------------------------------------------------------------------|----------------------------------|----|-------------|
|        | <b>Order- <u>Ciconiiformes</u><br/>Family- <u>Ardeidae</u></b>       |                                  |    |             |
| 1      | Indian Pond Heron                                                    | <u>Ardeola grayii</u>            | R  | LC          |
| 2      | Cattle Egret                                                         | <u>Bubulcus ibis</u>             | R  | LC          |
|        | <b>Order- <u>Accipitriformes</u><br/>Family- <u>Accipitridae</u></b> |                                  |    |             |
| 3      | Black Kite                                                           | <u>Milvus migrans</u>            | R  | LC          |
| 4      | Shikra                                                               | <u>Accipiter badius</u>          | R  | LC          |
|        | <b>Order- <u>Galliformes</u><br/>Family- <u>Phasianidae</u></b>      |                                  |    |             |
| 5      | Indian Peafowl                                                       | <u>Pavo cristatus</u>            | R  | LC          |
|        | <b>Order- <u>Gruiformes</u><br/>Family- <u>Rallidae</u></b>          |                                  |    |             |
| 6      | White-breasted Waterhen                                              | <u>Amaurornis phoenicurus</u>    | R  | LC          |
|        | <b>Order- <u>Charadriiformes</u><br/>Family- <u>Charadriidae</u></b> |                                  |    |             |
| 7      | Red-wattled Lapwing                                                  | <u>Vanellus indicus</u>          | R  | LC          |
|        | <b>Order- <u>Columbiformes</u><br/>Family- <u>Columbidae</u></b>     |                                  |    |             |
| 8      | Blue Rock Pigeon                                                     | <u>Columba livia</u>             | R  | LC          |
| 9      | Little Brown Dove                                                    | <u>Streptopelia senegalensis</u> | R  | LC          |
|        | <b>Order- <u>Psittaciformes</u><br/>Family- <u>Psittacidae</u></b>   |                                  |    | LC          |
| 10     | Rose-ringed Parakeet                                                 | <u>Psittacula krameri</u>        | R  | LC          |
| 11     | Alexandrine Parakeet                                                 | <u>Psittacula eupatria</u>       | R  | NT          |
|        | <b>Order- <u>Cuculiformes</u><br/>Family- <u>Cuculidae</u></b>       |                                  |    |             |
| 12     | Asian Koel                                                           | <u>Eudynamis scolopacea</u>      | R  | LC          |

|    |                              |                               |    |    |
|----|------------------------------|-------------------------------|----|----|
|    | <b>Family- Centropodidae</b> |                               |    |    |
| 13 | Greater Coucal               | <i>Centropus sinensis</i>     | R  | LC |
|    | <b>Order- Strigiformes</b>   |                               |    |    |
|    | <b>Family- Strigidae</b>     |                               |    |    |
| 14 | Spotted Owlet                | <i>Athene brama</i>           | R  | LC |
|    | <b>Order- Apodiformes</b>    |                               |    |    |
|    | <b>Family- Apodidae</b>      |                               |    |    |
| 15 | Little Swift                 | <i>Apus affinis</i>           | R  | LC |
|    | <b>Order- Coraciiformes</b>  |                               |    |    |
|    | <b>Family- Halcyonidae</b>   |                               |    |    |
| 16 | White-throated Kingfisher    | <i>Halcyon smyrnensis</i>     | R  | LC |
|    | <b>Family- Meropidae</b>     |                               |    |    |
| 17 | Green Bee-Eater              | <i>Merops orientalis</i>      | R  | LC |
|    | <b>Order- Bucerotiformes</b> |                               |    |    |
|    | <b>Family- Bucerotidae</b>   |                               |    |    |
| 18 | Indian Grey Hornbill         | <i>Ocyrceros birostris</i>    | R  | LC |
|    | <b>Order- Piciformes</b>     |                               |    |    |
|    | <b>Family- Megalaimidae</b>  |                               |    |    |
| 19 | Coppersmith Barbet           | <i>Megalaima haemacephala</i> | R  | LC |
|    | <b>Order- Passeriformes</b>  |                               |    |    |
|    | <b>Family- Hirundinidae</b>  |                               |    |    |
| 20 | Dusky Crag-Martin            | <i>Hirundo concolor</i>       | R  | LC |
|    | <b>Family- Oriolidae</b>     |                               |    |    |
| 21 | Indian Golden Oriole         | <i>Oriolous oriolus</i>       | R  | LC |
|    | <b>Family- Dicuridae</b>     |                               |    |    |
| 22 | Black Drongo                 | <i>Dicrurus macrocercus</i>   | R  | LC |
| 23 | Ashy Drongo                  | <i>Dicrurus leucophaeus</i>   | WV | LC |

|    |                                  |                                  |    |    |
|----|----------------------------------|----------------------------------|----|----|
|    | <b>Family- Sturnidae</b>         |                                  |    |    |
| 24 | Common Myna                      | <i>Acridotheres tristis</i>      | R  | LC |
|    | <b>Family- Corvidae</b>          |                                  |    |    |
| 25 | Rufous Treepie                   | <i>Dendrocitta vagabunda</i>     | R  | LC |
| 26 | Jungle Crow                      | <i>Corvus macrorhynchos</i>      | R  | LC |
|    | <b>Family- Irenidae</b>          |                                  |    |    |
| 27 | Common Iora                      | <i>Aegithina tiphia</i>          | R  | LC |
|    | <b>Family- Pycnonotidae</b>      |                                  |    |    |
| 28 | Red-vented Bulbul                | <i>Pycnonotus cafer</i>          | R  | LC |
|    | <b>Family- Leiothrichidae</b>    |                                  |    |    |
| 29 | Jungle Babbler                   | <i>Turdoides straitus</i>        | R  | LC |
|    | <b>Family- Muscicapidae</b>      |                                  |    |    |
| 30 | Taiga Flycatcher                 | <i>Ficedula albicilla</i>        | WV | LC |
| 31 | Red-breasted Flycatcher          | <i>Ficedula parva</i>            | WV | LC |
| 32 | Tickell's Blue Flycatcher        | <i>Cyornis tickelliae</i>        | R  | LC |
| 33 | Grey-headed Canary Flycatcher    | <i>Culicicapa ceylonensis</i>    | WV | LC |
| 34 | Oriental Magpie Robin            | <i>Copsychus saularis</i>        | R  | LC |
| 35 | Black Redstart                   | <i>Phoenicurus ochrurus</i>      | WV | LC |
| 36 | Indian Robin                     | <i>Copsychus fulicatus</i>       | R  | LC |
|    | <b>Family- Rhipiduridae</b>      |                                  |    |    |
| 37 | White-spotted Fantail-Flycatcher | <i>Rhipidura albogularis</i>     | R  | LC |
|    | <b>Family- Cisticolidae</b>      |                                  |    |    |
| 38 | Ashy Prinia                      | <i>Prinia socialis</i>           | R  | LC |
| 39 | Common Tailorbird                | <i>Orthotomus sutorius</i>       | R  | LC |
|    | <b>Family- Sylviidae</b>         |                                  |    |    |
| 40 | Sulphur-bellied Warbler          | <i>Phylloscopus griseolus</i>    | WV | LC |
| 41 | Greenish Warbler                 | <i>Phylloscopus trochiloides</i> | WV | LC |

|    |                              |                                |    |    |
|----|------------------------------|--------------------------------|----|----|
| 42 | Lesser Whitethroat Warbler   | <i>Sylvia curruca</i>          | WV | LC |
|    | <b>Family- Dicaeidae</b>     |                                |    |    |
| 43 | Thick-billed Flowerpecker    | <i>Dicaeum agile</i>           | R  | LC |
| 44 | Tickell's Flowerpecker       | <i>Dicaeum erythrorhynchos</i> | R  | LC |
|    | <b>Family- Nectariniidae</b> |                                |    |    |
| 45 | Purple-rumped Sunbird        | <i>Nectarinia zeylonica</i>    | R  | LC |
| 46 | Purple Sunbird               | <i>Cinnyris asiaticus</i>      | R  | LC |
|    | <b>Family- Zosteropidae</b>  |                                |    |    |
| 47 | Oriental White-Eye           | <i>Zosterops palpebrosa</i>    | R  | LC |
|    | <b>Family- Passeridae</b>    |                                |    |    |
| 48 | House Sparrow                | <i>Passer domesticus</i>       | R  | LC |
|    | <b>Family- Estrildidae</b>   |                                |    |    |
| 49 | Indian Silverbill            | <i>Lonchura malabarica</i>     | R  | LC |
|    | <b>Family- Motacillidae</b>  |                                |    |    |
| 50 | Yellow Wagtail               | <i>Motacilla flava</i>         | WV | LC |
| 51 | White Wagtail                | <i>Motacilla alba</i>          | WV | LC |

R- Resident, WV- Winter Visitor, LC- Least Concerned and NT- Near Threatened

The college must be appreciated for maintaining such a high quality of flora & fauna as seen above.

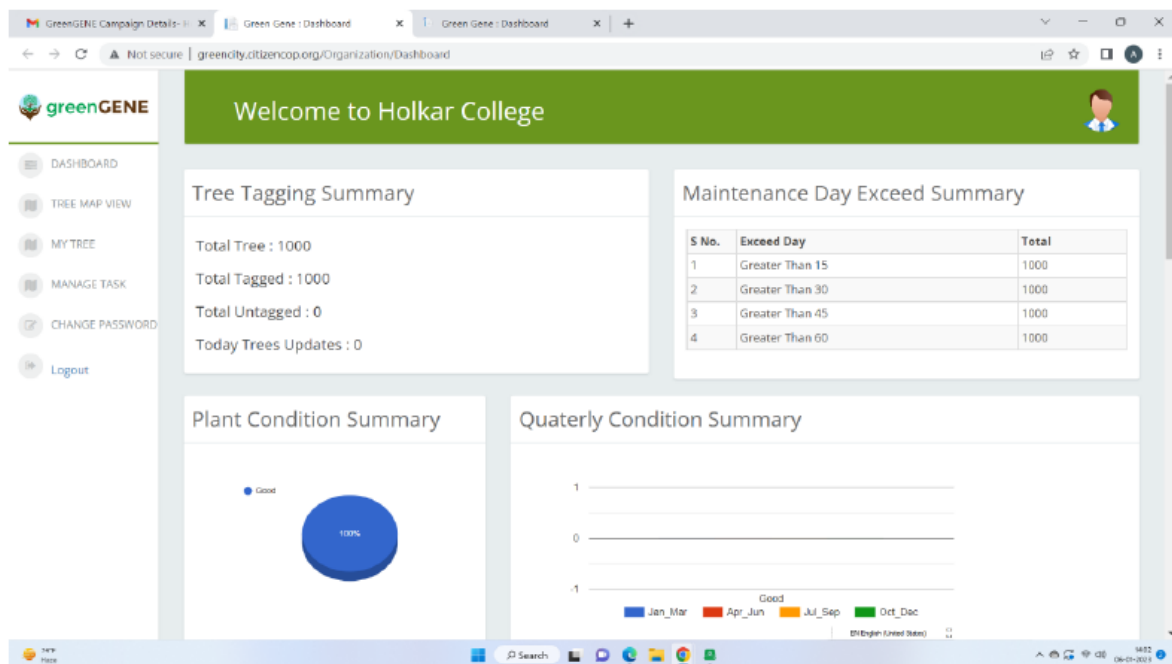
## 11.13 RESULT

### 11.13.1 Fauna Survey Pilot fauna survey:

A total of Thirty-five animal species were cited in the college area sampled. Fauna species observed in the study area were good representatives of the animal kingdom as they cut across the insect group, other invertebrates, reptiles, amphibians, birds and the mammals.

Fauna species were noted to be common to each of the study areas. Among the fauna species common to the college study area, termites, ants, earthworms, lizards, spiders and springtails were observed to be more in abundance.

Total 1000 trees have been Geotagged. It's a great to know that college has worked extra ordinarily and scientific methods has been adopted.



### 11.13.2 Some evidence shown for Fauna



### 11.14 Flora survey:

Direct observation of plants growing freely around the college was done to ensure a proper and more accurate plant survey. The collected plant samples were identified in the herbarium of the Department of Botany.

We have identified different trees from different genera and families and ornamental plants and have studied their properties and uses. There are many trees and ornamental plants which are rare on the college campus. Such plants are planted in different parts of campus and monitored for proper growth. Plants which are having frequency less than 0.1% were chosen for conservation. These are some plants chosen for vegetative propagation that includes, *Pisonia alba*, *Leucaena leucocephala*, *Thespesia populnea*, *Aloevera*.

The highest diversity of plants was observed on the college campus with 38 plant species. The number of *Azadirachata indica* was found to be the highest planted trees. *Phyllanthus niruri* was the second topmost plant found in the campus area. *Millingtonia hortensis* was the third topmost plant found in the campus area. *Holoptelea integrifolia* and *Pongamia pinnata* are commonly found plants. Only five plant species (*Synedrella nodiflora*, *Sida acuta*, *Euphorbia hirta*, *Commelina benghalensis* and *Amaranthus spinosus*) were common to all the study sawmills while *Abutilon mauritianum*, *Axonopus compressus*, *Euphorbia hysoppifolia*, *Gomphrena celosoides* and *Sida rhombifolia* occurred in four of the five sawmill locations.

### Plantation Details

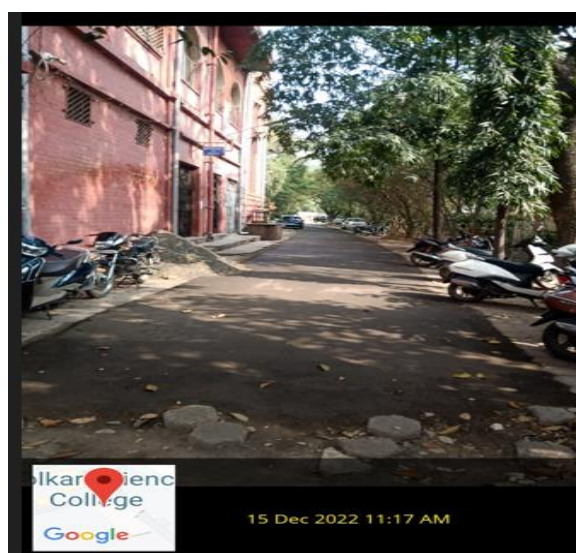
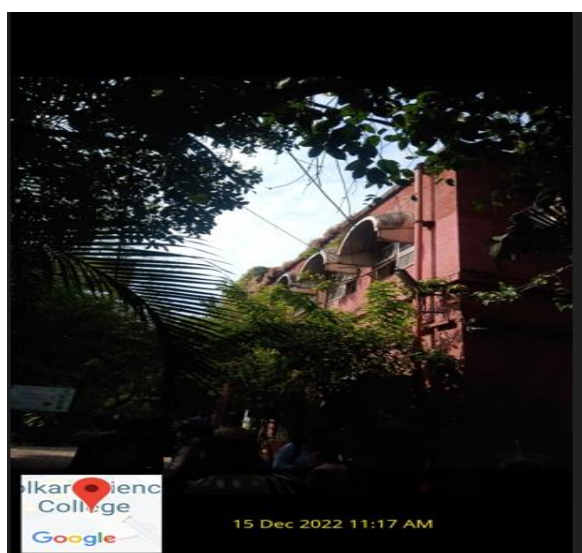
| Year of Plantation | No. of Plantation Details |               | No. of Plant Survived |               | Overall Percentage |
|--------------------|---------------------------|---------------|-----------------------|---------------|--------------------|
|                    | Campus                    | Out of Campus | Campus                | Out of Campus |                    |
| 2022               | 150                       | 139           | 50                    | 20            | 37.03%             |
| 2021               | 100                       | 87            | 50                    | 19            | 36.89%             |
| 2020               | Online                    | 147           | 112                   | 96            | -                  |
| 2019               | 220                       | 129           | 50                    | 21            | 20.34%             |
| 2018               | 580                       | 180           | 100                   | 42            | 18.68%             |
| 2017               | 500                       | -             | 211                   | -             | 42.2%              |
| 2016               | 250                       | 250           | 119                   | 86            | 41%                |

No. of Plantation is good considering the area of campus, but survival rate is low. College authority must plan for making a committee to consider type of plants (Mainly fruit bearing having medicinal values, like *Sehajan*, *Papaya*, *Jamun* etc.) & also follow up of their survival must be ensured.

**Govt.Holkar (Model, Autonomous) Science College, Indore**  
**Department of NSS**  
**Plantations**

| Year | No. Of Plantations Details |               | No. Of Plant Survived |               | Name Of Plants                                                                                                                                          |
|------|----------------------------|---------------|-----------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | Campus                     | Out Of Campus | Campus                | Out Of Campus |                                                                                                                                                         |
| 2022 | 150                        | 139           | 50                    | 20            | Amrand(8), karani(12), mango(10), gudhal(10), adusa(5), badam(5), jamun(10), neem(10)                                                                   |
| 2021 | 100                        | 87            | 50                    | 19            | Shisam(12), mango(9), gulmohar(12), champa(7), kaner(10), anvla(10), kadam(9)                                                                           |
| 2020 | Online                     | 147           | 112                   | 96            | amrud(20), kaner(15), gulab(22), pipal(10), arandi(15), sirsi(5), sitafal(24), baheda(6), anvla(18), mango(33), gulmohar(22), badam(10), neem(8),       |
| 2019 | 220                        | 129           | 50                    | 21            | gudhal(10), adusa(5), shisham(8), karani(8), amrud(10), jamun(15), mango(15)                                                                            |
| 2018 | 580                        | 180           | 100                   | 42            | Eucalyptus(8), arandi(10), karani(20), kaner(20), gulab(15), jamun(8), gulmohar(12), mango(10), sitafal(7), gudhal(8), champa(10), sesame(4), amrud(10) |

**GREAT ACHIEVEMENT DURING 2021 & 2022**



Depiction of Lush Green Campus with shady trees of Govt. Holkar Science College, Indore

As per the report received from the college that in 2022 total trees planted is 289 whereas in 2021 total 187 trees were planted. This shows an achievement 102 trees since last year. Although if we consider plantation details from 2016. Although survival rate is low. Some additional care needs to be taken so that survival rate of plant to reach at least 80% in campus and 50% out of campus.

### 11.15 Discussion

The major component of an ecosystem is plants. They are major modifiers of climate and providers of community structures, and they are pathway through which energy enters the ecosystem. The plant forms a complex interaction between the biotic and abiotic entities of the environment by making use of the biotic entities as food to produce food in form of biomass for the animal communities. High diversity of animal species within the college vicinity as recorded in this study could therefore be connected to the observed high diversity of plant species.

This study has shown that the college environments have rich and abundant flora and fauna populations which could be regarded as a biotic community consisting of the populations of different organisms interacting together. It also revealed that the activities in the study area may not be completely detrimental to the existence of the organisms. Thus, if well maintained, college activities are not entirely unfriendly to the biotic community.

Although, it is not a common practice to base ecological research on questionnaire surveys, this study has revealed that the opinion of people who have been used to a particular area over a long period of time on the fauna species usually encountered in such areas should not be discarded. However, there is the need for a field survey to back up verbal responses.

| English Name     | Common Name  | Number | Uses                                                                                                                                            | Economic Importance                                                                                                                                        | Medicinal Use                                                                                                                                                                                                               |
|------------------|--------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Indian Beach     | Karanja      | 24     | Nitrogen fixing plant. It's Seeds produce 30% to 43% oil                                                                                        | Lamp oil, in soap making and as lubricant                                                                                                                  | Treatment of Tumors, piles, skin diseases & Ulcers, also excellent source of Plant Protein                                                                                                                                  |
| False Ashok      | Ashok        | 4      | Air purifying tree, grown for fuel wood for India and Africa                                                                                    | Making medicines plant                                                                                                                                     | Best used to treatment for gynecological problems and treat all illnesses                                                                                                                                                   |
| The Margosa Tree | Neem         | 29     | It will reduce erosion, desertification, and perhaps even slow the rate of increase in population                                               | Used de-oiled neem cake as a fertilizer in their fields                                                                                                    | Neem has antiviral, antioxidant, and can use for acne                                                                                                                                                                       |
| Indian Laburnum  | Amaltas      | 233    | Amaltas used in for all ayurvedic formulations and boosting overall immunity                                                                    | Used for making perfumes                                                                                                                                   | Uses for migraines, chest pain and blood dysentery                                                                                                                                                                          |
| Emblic Myribolan | Amla or Amla | 7      | Amla is citrus food and it can give a boost boost to your immune health and decrease the ill-effects of air pollution                           | Source of vitamin c and its diuretic, aperient                                                                                                             | Its good for heart health, and also beneficial for skin and hair                                                                                                                                                            |
| Drumstick tree   | Sehajan      | 29     | It contains vital B-complex vitamins such as folates, vitamin B6 (pyridoxine), thiamine (vitamin B-1), riboflavin, pantothenic acid, and niacin | It is widely cultivated for its young seed pods and leaves, used as vegetables and for traditional herbal medicine. It is also used for water purification | one of the finest sources of minerals like calcium, iron, copper, manganese, zinc, selenium, and magnesium, contains 18 amino acids which helps in treating many diseases. One important use is its anti-diabetic property. |

| English Name    | Common Name | Number | Uses                                                                                                                                        | Economic Importance                                                                                                                                                             | Medicinal Use                                                                                                                                                                                                  |
|-----------------|-------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scholars Tree   | Satparani   | 37     | Some other species of Alstonia are known to produce light timber. It is also grown in nurseries as an ornamental tree in gardens and parks. | Tree of Heaven can be used for cabinetry, turned objects, and paper (pulpwood)                                                                                                  | Indians as traditional medicine to treat diarrhoea, dysentery, asthma, and a few types of fevers                                                                                                               |
| Indian Jujube   | Ber         | 6      | Ber has been used in the soil conservation of dune lands, where it stabilises the soil by the storage and recycling of plant nutrients.     | source of seeds, timber, fodder, medicines and potential industrial components.                                                                                                 | It is used for skin rejuvenation, wound healing, promoting digestion, strengthening bones, and weight loss                                                                                                     |
| Flamboyant Tree | Gul Mohar   | 151    | Gulmohar is used in folk medicine to treat a range of diseases and disorders, including constipation, inflammation,                         | The wood is used for fuel, the calorific value of the wood being 4600 kcal/kg. Its flowers are used in producing bee forage                                                     | antibacterial, anti-inflammatory, antifungal, antimicrobial, antioxidant, antimalarial, gastro-protective, cardio-protective along with wound healing properties.                                              |
| Mango           | Aam         | 18     | absorbs carbon dioxide from the environment in mango tree climate zones around the world                                                    | Wood is extensively used for low-cost furniture, floor, ceiling boards, window frames, heavy packing cases, match splints, brush backs, oar blades, agricultural implements etc | dentrifrice, antiseptic, astringent, diaphoretic, stomachic, vermifuge, tonic, laxative and diuretic and to treat diarrhea, dysentery, anaemia, asthma, bronchitis, cough, hypertension, insomnia, rheumatism, |
| Indian Almond   | Badam       |        | almonds are used for producing almond oil, which is widely used in pharmacy                                                                 | production of bioenergy products such as biochar, biodiesel, bio-oil, bioethanol [58]. Bioenergy industry holds                                                                 | Almonds contain calcium, magnesium, manganese, copper, vitamin K, protein, and zinc, all of which contribute Trusted Source to bone health.                                                                    |

| English Name | Common Name | Number | Uses                                                                                                                                                                          | Economic Importance                                                                                                                      | Medicinal Use                                                                                                                                                 |
|--------------|-------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              |             |        | (cosmetics and other                                                                                                                                                          | great promise for our economy, environment, and society.                                                                                 |                                                                                                                                                               |
| The Banyan   | Bargad      | 13     | The Banyan tree is one of the most magical tree, it is one of the few elements in nature which is useful in every single aspect                                               | <b>The wood of the Banyan tree is used in making door panels, boxes and the other items.</b> Its bark is used for making paper and ropes | 1. Cure Diarrhea · 2. Treat vaginal Infection · 3. Helpful in Diabetes · 4. Treat Acne and Patches on Skin · 5. Banyan Tree for Cholesterol ·                 |
| Sacred Fig   | Pipal       | 13     | provides ample Oxygen, purifies the surrounding, kills harmful bacteria, control soil erosion, improve soil structure and its fertility, it is also dust and sound absorbent. | Peepal tree leaves contain Glucose, Asteriod and Mennos, Phenolic while its bark is rich in Vitamin K, tainen and Phaetosteroline.       | cough, paralysis, asthma, diarrhoea, ear pain, toothache, haematuria (blood in urine), migraine, scabies, eye troubles, and gastric problems.                 |
| Tamarind     | Imli        | 3      | From boosting your immunity to keeping your liver and heart safe from diseases, tamarind do your health a world of good                                                       | Tamarind lumber is used to make furniture, carvings, and household objects and the making of tools.                                      | People take tamarind for constipation, liver and gallbladder problems, and stomach disorders. It is also used to treat colds and fever                        |
| Curry Leave  | Meetha Neem |        | Neem is extremely useful in urban forestry because it has remarkable ability to withstand air and water pollution as well as heat.                                            | uses of neem and the benefits derived, such as biomass production, timber, seed and honey are more tangible and quantifiable             | anti-diabetic, cholesterol reducing property, anti-diarrheal, antioxidant, antiulcer, antimicrobial, antibacterial and many more useful medicinal properties. |
| Guava        | Amrood      | 33     | Guavas are not fussy about soil and will thrive in heavy clay or light sandy soils. You do not need to extensively                                                            | Dehydrated guavas may be reduced to a powder which can be used to flavour ice cream,                                                     | Guava helps boost your immunity · 2. May reduce the risk of developing Cancer · 3. Helps to manage blood sugar levels                                         |

| English Name  | Common Name   | Number | Uses                                                                                                                                                                               | Economic Importance                                                                                                                                                         | Medicinal Use                                                                                                                                                        |
|---------------|---------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |               |        | prepare the ground before planting your guava                                                                                                                                      | confections and fruit juices, or boiled with sugar to make jelly                                                                                                            |                                                                                                                                                                      |
| Wild Tamarind | Jungle Jalebi | 8      | It is attractive to pollinating insects like bees because the flowers contain pollen. In the end, high quality honey                                                               | For its medicinal properties, the bark of the tree has been used in the treatment of dysentery, fever, diabetes, and ulcers                                                 | jungle jalebi contains vitamin C, vitamin B1, B2, B3, vitamin K, iron, calcium, phosphorus, protein, dietary fibre, sodium and vitamin A.                            |
| Pine Tree     | Chir          | 30     | The uses of chir pine as a timber and fuelwood are among few major indigenous uses of this species in Uttaranchal                                                                  | fabrication of panel products and for constructional and also yield a commercially important oleo-resin which forms the raw material for rosin and turpentine oil industry. | helps manage diabetes by increasing insulin secretion due to its anti-diabetic property                                                                              |
| Eucalyptus    | Nilgiri       | 2      | <b>helps control pollution, especially particulate pollution.</b> The particles are trapped on the leaves, and washed to the ground when it rains – thus staying out of our lungs. | utilized for fuel wood production (for fire), pole production, house building, medicine (e.g. blue gum used to treat flue, common cold), timber production [6]              | Antimicrobial properties · Colds and respiratory problems · Eucalyptus and dental care · Fungal infections and wounds.                                               |
| Sissoo        | Shisham       | 13     | It is the most well-known and widely traded rosewood species, but it is also used as fuel wood, as well as for shade and shelter                                                   | manufacturing furniture, it is also used as a fuel as the wood makes a great source for charcoal used in heating as well as cooking.                                        | curing body irritation, stomach irritation, eye diseases, fever, ulcers, anemia, and other health issues. It also helps with excessive bleeding in menstrual cycles. |

| English Name  | Common Name | Number | Uses                                                                                                                                                                      | Economic Importance                                                                                                                            | Medicinal Use                                                                                                                                                                  |
|---------------|-------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Yellow Champa | Son Champa  | 10     | Champak tree rich in medicinal properties is used in several ayurvedic preparations. The leaves, root, root bark, flowers, fruit and oil are used for its medicinal value | Flowers are source of Champa oil or Champaca oil, used in perfumery. Flowers are also used in preparation of attars and perfumed hair oils.    | diarrhea, cough, bronchitis, hypertension, dyspepsia, fever, rheumatism, abscesses, dysmenorrhea and inflammation. It is also used as purgative,                               |
|               | Jaamun      | 2      | inauspicious for homes and effect health of occupants. The cleansing of the air helps in keeping the surrounding rich in oxygen.                                          | This juicy fruit holds a great significance in holistic treatments like Ayurvedic, Unani and Chinese medicine as it attenuates Kapha and Pitta | keep your heart healthy and keep heart issues away. The dietary fibers and antioxidants in Jamun are ideal for regulating cholesterol levels and obstructing plaque formation. |
| Cotton        | Kapas       | 1      | food, fiber, and even fuel for over 6,000 years. You can find cotton in your clothes, sheets, and towels, but cotton is also used to make things like rope                | used in stuffing the pillows and cushions. It is also used in making rubber tyres, carpets, blankets and cordages are made from cotton         | nausea, fever, headache, diarrhea, dysentery, nerve pain, and bleeding                                                                                                         |
|               | Mahogni     | 55     | Medicinal properties in mahogany bark may hold colon cancer cure                                                                                                          | paneling and to make furniture, boats, musical instruments and other items.                                                                    | malaria, hypertension, diabetes and diarrhea, as antipyretic, as bitter tonic and astringen                                                                                    |
| Conocarpus    | Conocarpu s | 20     | Evergreen shrub tree. · Can be used as a shed, wood or noise barrier. · Great plant for deforestation and to combat global warming.                                       | plants not only produces lumber, large biomass but also accumulates large quantities of metals in them while reducing the risk of metals       | diseases as catarrh, conjunctivitis, gonorrhea, diarrhea, fever, orchitis and syphilis Phenolic compounds are the major secondary metabolites of this species.                 |

| English Name | Common Name  | Number | Uses                                                                                                                                                                         | Economic Importance                                                                                                                                                                                   | Medicinal Use                                                                                                                                                                                 |
|--------------|--------------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              | Papaya       | 3      | papaya seeds contain anti-bacterial activity that inhibits growth of gram-positive and gram-negative organisms. Observed activity was independent of stage of fruit maturity | manufacturing of processed food products like Jams, jellies, marmalades, fruit cheese and nectars.                                                                                                    | preventing and treating gastrointestinal tract disorders, intestinal parasite infections, and as a sedative and diuretic. It is also used for nerve pains (neuralgia) and elephantoid growths |
| Thuja        | Vidhya       | 38     | Thuja Occidentalis is used as pollution indicator plant as its leaves turn yellow with increase in SO2 in the environment.                                                   | like their potential role in agriculture, food supply and income by providing goods and services,                                                                                                     | leaves and leaf oil are used as a medicine. Thuja is used for respiratory tract infections such as bronchitis, bacterial skin infections, and cold sores.                                     |
| Banana       | Kela         | 27     | banana peels are a rich source of nutrients your plants crave: Potassium, phosphorus, and calcium, along with a host of other minerals your plants need.                     | Used as dessert fruit and for culinary purpose. The leaves are used as biological plates. The various products like banana puree, powder, flour, chips, vinegar, jam, jelly and wine can be prepared. | low levels of potassium in the blood (hypokalemia), constipation, and diarrhea. They are also used for diabetes, high cholesterol,                                                            |
|              | Paras Peepal | 4      | provides ample Oxygen, purifies the surrounding, kills harmful bacteria, control soil erosion, improve soil structure and its fertility,                                     | a storehouse of medicinal value and is used to treat many ailments and diseases, ranging from a simple incident like a snake bite to Asthma, skin diseases, kidney diseases                           | cough, asthma, diarrhoea, ear pain, toothache, haematuria (blood in urine), migraine, scabies, eye troubles, and gastric problems.                                                            |

| English Name | Common Name | Number | Uses                                                                                                                                       | Economic Importance                                                                                                                                                                                                          | Medicinal Use                                                                                                                                                                                                              |
|--------------|-------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              | Achiote     | 33     | annatto seeds are a colorful, healthy, and nutritious addition to the diet.                                                                | the ground seed is commercialized as condiment or colorant for food;Achiote also has many traditional uses as a dye, from red body paint to hair dye                                                                         | Annatto is commonly used in Peruvian herbal medicine today, and treating asthma, desiasa and any other treatment also.                                                                                                     |
| Jackfruit    | Kathal      | 1      | It is unique because it is used as a fruit, nut, vegetable, a good source of carbohydrate and healthy meat alternative.                    | The unripe fruits of “kathal” is used for vegetable, pickle and for the preparation of jellies                                                                                                                               | Being rich in calcium, magnesium, and phosphorus, Kathal is the perfect fruit for encouraging better bone health. anticarcinogenic, antimicrobial, antifungal, anti-inflammatory, wound healing, and hypoglycemic effects. |
| Bamboo       | Baans       | 1      | Houses, schools and other buildings. Today, over one billion people in the world live in bamboo houses.                                    | Bamboo has many uses, mainly in construction (flooring, roofing designing, and scaffolding), furniture, food, biofuel, fabrics, cloth, paper, pulp, charcoal, ornamental garden planting, and environmental characteristics, | Bamboo helps in managing acne, skin eruptions and wounds due to its anti-inflammatory and anti-bacterial properties. In Ayurveda,                                                                                          |
| Bougainville |             | 1      | Bougainvillea is a pollution tolerant plant and can help in the mitigation of air pollution beside its ornamental value in the landscaping | Bougainvillea spectabilis is extensively commercialized as an ornamental and hedge plant                                                                                                                                     | anticancer, antidiabetic, antihepatotoxic, anti-inflammatory, antihyperlipidemic, antimicrobial, antioxidant, and antiulcer properties.                                                                                    |

| English Name | Common Name | Number | Uses                                                                                          | Economic Importance                                                                                   | Medicinal Use                                                                                                                                                                                                                                                       |
|--------------|-------------|--------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pineapple    | Ananas      | 1      | protect against inflammation and disease. It's commonly eaten baked, grilled, or freshly cut. | Pineapple leaves are used to make cloth and rope, while the whole plant is used as a source of energy | anti-inflammatory and pain-relieving properties. This helps when you have an infection, like sinusitis, or an injury, like a sprain or burn. It also offsets the joint pain of osteoarthritis. The vitamin C in pineapple juice also keeps inflammation levels low. |



## 12.0 Fire Fighting

Every educational institution must have a minimum of two staircases, two fire extinguishers on each floor and manually operated fire alarm call points on each floor. Every classroom that can seat more than 45 students must have two exits and fire drills should be conducted once in six months.

### 12.1 Fire safety norms in India

The height shall be a fire tower and in such a case width of the same shall not be less than the width of the main staircase. No combustible material shall be allowed in the fire tower. a) The use of spiral staircase shall be limited to low occupant load and to a building height 9 m.

## *12.2 Measures to assess fire safety*

Fire safety is a fundamental consideration in building design and management, but unfortunately, firewalls that are often overlooked are today more likely to be associated with IT security than with physical safety.

Assess fire safety measures in your built environment with the help of this checklist.

### *12.2.1 Provide adequate means of escape*

The first rule of fire management requires sufficient escape routes out of the building, in accordance with its scale and occupancy. The number, size and location of exits are specified in the National Building Code (NBC) 2005, a detailed set of guidelines for constructing, maintaining and operating buildings of all types. Office occupiers must additionally ensure that staircases, stairwells and corridors are well-maintained, ventilated and free of obstacles in order to be effective in an emergency.

### *12.2.2 Outline clear pathways to exit doors*

Getting to exits is as important as providing enough exits. NBC guidelines specify the maximum distance a person must travel in order to access a fire exit, and the importance of photo-luminescent signage to enable evacuation at night. Refuge areas such as terraces are critical for high-rises where people can safely congregate, when asked to leave the building in phases.

### *12.2.3 Install smoke detection systems*

The first few minutes of a fire are crucial in containing it. Automatic fire alarm systems such as smoke and heat detectors are mandatory elements in international building codes, and particularly useful in spotting fires during times when occupancy in the building is low.

### *12.2.4 Maintain smoke suppression systems*

Fire extinguishers are only useful if they work, so check them regularly. High-rise buildings, which are harder to access and evacuate, should consider installing automatic sprinkler systems. The National Fire Protection Association (NFPA), a US-based non-profit body, estimates that automatic suppression systems lower the cost of damage by 60%.

### *12.2.5 Conduct Regular Fire Drills*

Preventing panic in an emergency is as important as staying away from flames and fumes. Regular fire drills familiarize people with emergency evacuation methods at little cost. Nominate a fire safety officer in every building to ensure that this becomes standard operating procedure.



#### *12.2.6 Use flame-retardant materials in interiors*

Materials used in the interior can save or endanger lives. The combination of wood, paper and textiles makes workstations highly combustible. Fabrics can be made flame-retardant, however, so that they self-extinguish when lit. An increasing number of companies, especially multinationals, request such fabrics despite their price premium, according to data from Indian office furniture manufacturer BP Ergo. Stringent fire regulations abroad make it necessary for US furniture makers such as Herman Miller to provide only fire-tested fabrics. Doors are also assigned a fire-resistance rating, measuring how long they can remain resistant to excessive temperatures and flames without collapsing.

#### *12.2.7 Make office accessible to firefighters*

Grilled windows are a widespread urban phenomenon. Occupants of offices in residential buildings with few exits should be wary of locking themselves into confined spaces.

#### *12.2.8 Keep the building plans handy*

It is imperative to make multiple copies of your building plan available to guide rescue agencies, especially during an emergency.

#### *12.2.9 Ask the local fire brigade to assess safety*

Fire departments, for a nominal fee, will independently assess your building's level of fire safety. Storage of hazardous or inflammable materials, old and unstable structures, inadequate escape routes or electricity overloads are potential death traps that are best assessed by professionals.

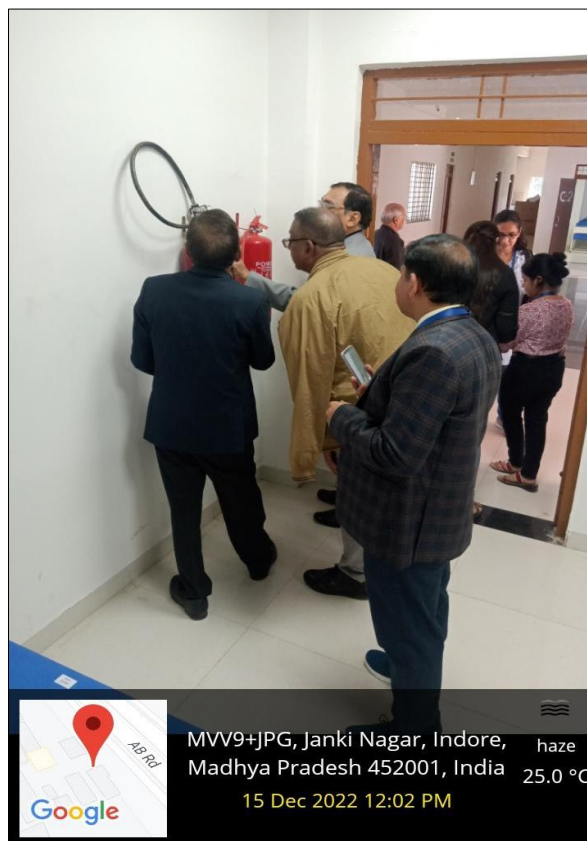
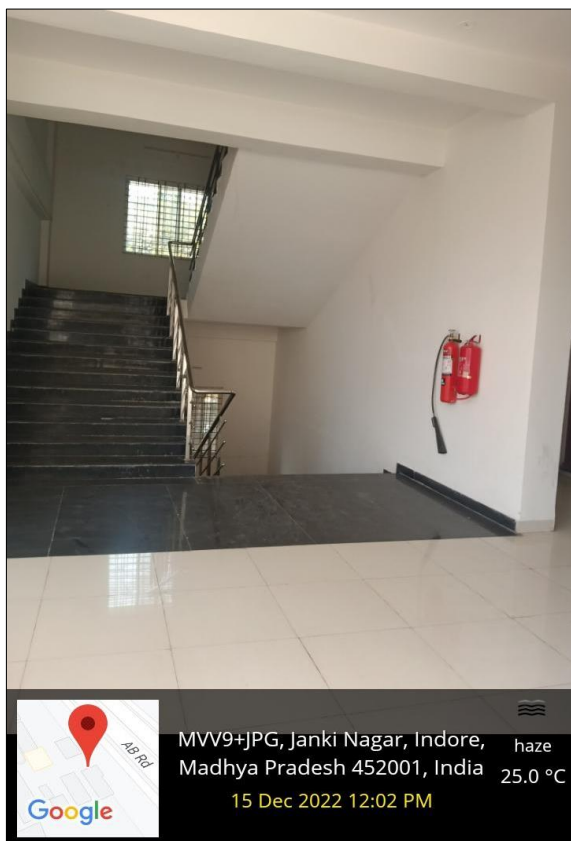
#### *12.2.10 Comply with National Building Code*

"Green buildings" are in vogue, but safe structures are sadly not. The code endeavors to avoid requirements that might involve unreasonable hardships or unnecessary inconvenience or

interference with normal use and occupancy of buildings, insist upon compliance with minimum standards for fire safety necessary in public interest.

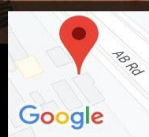
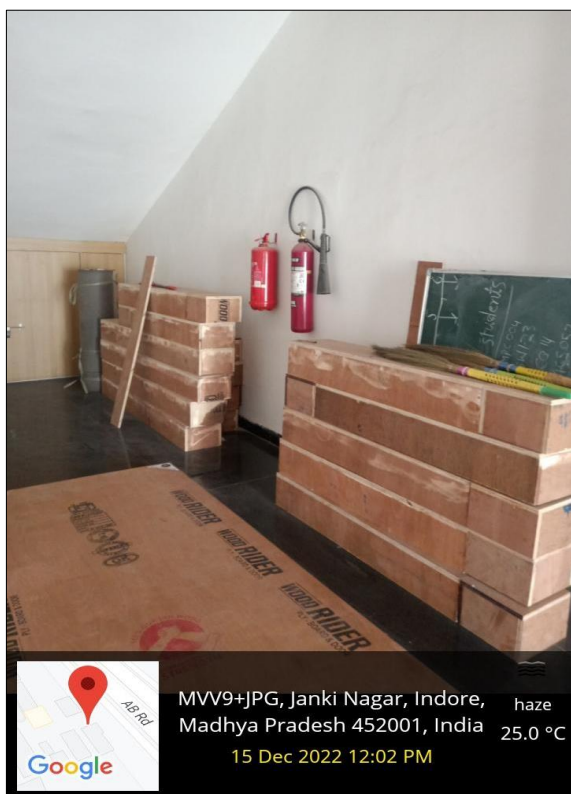
At Holkar Science Campus different locations fire safety devices were checked and it was found that proper refilling date, next filling date were mentioned on the device. Staff nearby were asked about the operation, and it was found they were acquainted with the operation of the firefighting devices. It is recommended to hold a fire safety drill once a year so that proper awareness should be there among the staff and the students.

### 12.2.11 Fire Fighting Equipment in Chemistry lab

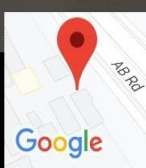
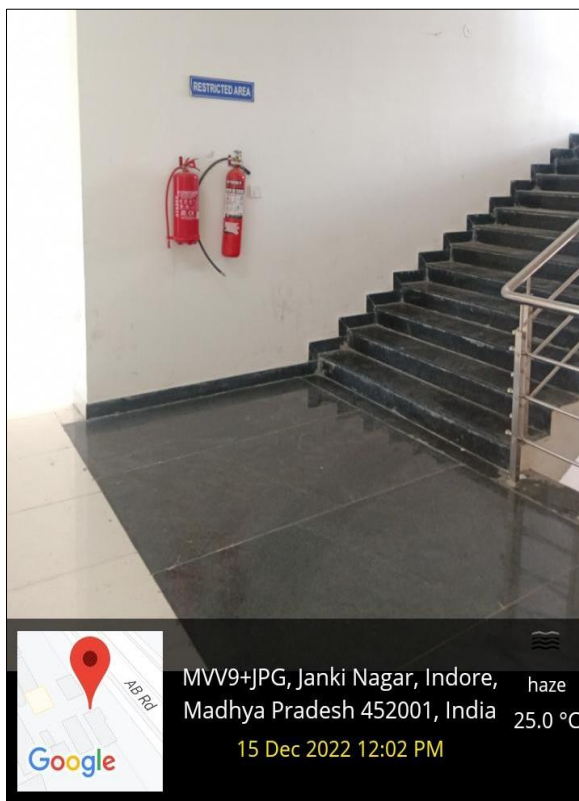


### 12.2.12 Fire Fighting equipment at staircase





MVV9+JPG, Janki Nagar, Indore, Madhya Pradesh 452001, India  
haze 25.0 °C  
15 Dec 2022 12:02 PM

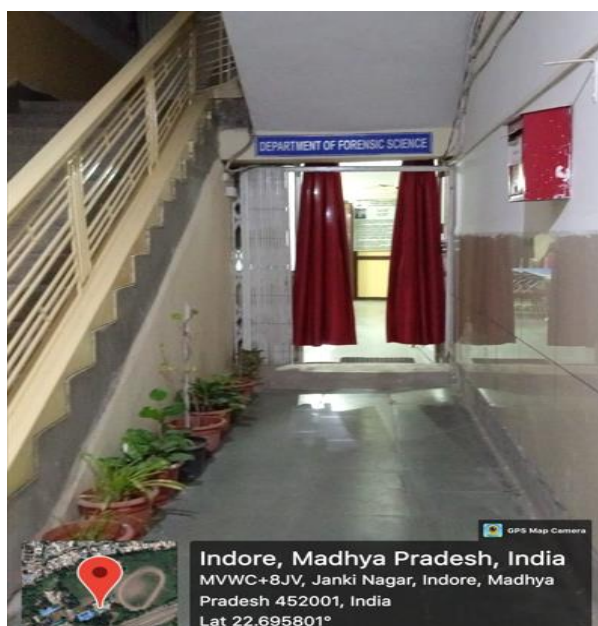


MVV9+JPG, Janki Nagar, Indore, Madhya Pradesh 452001, India  
haze 25.0 °C  
15 Dec 2022 12:02 PM

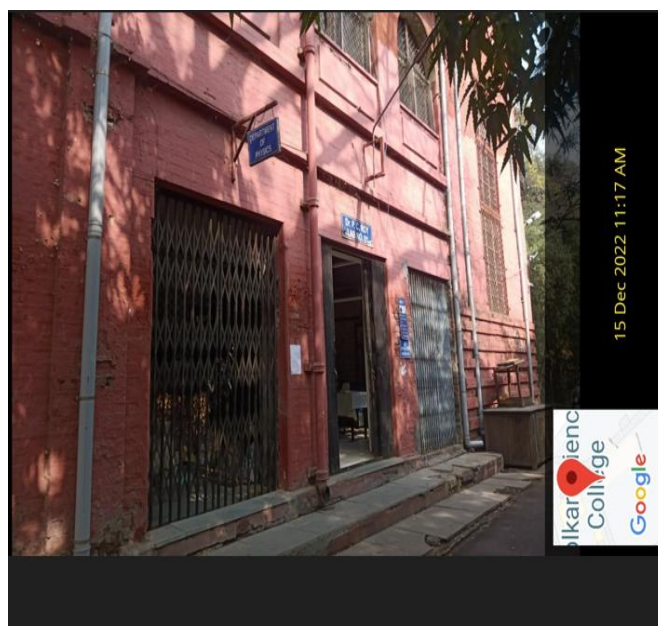
Fire Fighting Equipments at different locations with UpToDate refilling, testing and next due dates

### 12.3 Sanitation & Hygiene.

College administrations are very conscious about Hygiene & Sanitation. Wherever the toilets were inspected, they were found neat and clean. Even the cafeteria was well sanitized with food stuff secured from dust & pollution. **Two napkin incenerator** were also provided in the campus areas for females. This type of facilities are very rarely found in college campus. Such provision show care of the college towards females. Our Loving Prime Minister also during address on 15<sup>th</sup> August 2022 speech appealed for respect toward women. This is in line of our loving PM.



Indore, Madhya Pradesh, India  
MVWC+BJV, Janki Nagar, Indore, Madhya Pradesh 452001, India  
Lat 22.695801°



15 Dec 2022 11:17 AM

Physics Department. Being such old building but maintained

## 12.4 Innovative creation of Holkar College:

College is running a mushroom composting unit. This unit is very helpful for student to learn mushroom and composting also. This can help to earn & learn also.



## 13.0 Recommendations

Based on the above audit report certain recommendations/ suggestions are given as below:

### *Water Quality & Quantity Monitoring*

1. Water meter need to be installed at all submersibles to calculate the quantity of water. Also, near source of municipal water supply.
2. Chlorination of water to be done at regular interval & testing of chlorinated water shall be conducted.
3. Cleaning of water tanks at least once in year must be ensured.

### *Air Quality Monitoring*

1. Air Quality monitoring system to be installed.
2. At certain locations, it shall be displayed publicly to be awareness of all.

### *Waste Management*

1. It shall be ensured that Chemical waste being disposed through lab to be properly analyzed before dispersal.
2. Promote plastic free Zone campus through posters/ banners.
3. E-Waste to be sent to SPCB approved recycler as soon as possible.

### *Energy*

1. Several suggestions have been given in the sections. If recommendation is accepted, then college will save annual revenue of Rs.10 lacs.
2. College is already purchasing star rated appliance.

### *Renewable Energy*

1. College has done a commendable work in last 1 year by producing renewable energy of 25kW.
2. A regular process shall further be continued.
3. This renewable energy is saving Rs. 6 lacs annually.

### *Biodiversity*

1. In last 2 years' college has planted 289 trees & 187 trees.
2. Rate of survival is very low. It need to be watched.
3. Only planting tree is not important unless survival rate is high.
4. A team of faculty may be made to monitor & plan the types of trees.
5. Preference to be given to trees having medicinal values.
6. Certain fruit bearing trees like sehajan, papaya which are very good in all respects.
7. One or two water body shall be developed in the college campus area. This will attract different species like birds, insects & animals.

### *Firefighting*

Fire Fighting equipments to be checked periodically & refilled timely.

## 14.0 References

1. International Journal of preventive medicine research Potential Health Impacts of Hard Water PMCID: PMC3775162 PMID: 24049611, Int J Prev. Med. 2013 Aug; 4(8): 866–875.
2. Various newspaper cuttings
3. From EPA (Environment Protection Agency, USA) guidelines.
4. IS: 150200: 2012
5. Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974)
6. Air (Prevention and Control of Pollution) Act, 1981 (21 of 1981);
7. Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008,
8. Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016 with amendments
9. The State Pollution Control Board, an annual return containing the details specified in Form 4 on or before the 30th day of June, of every year.
10. Diversity of spiders Holkar science college, Indore (M. P.), by V.K. SHARMA  
Department of Zoology, Government Holkar Science College, Indore, Madhya Pradesh, India



## *Certificate of Training*

TNV hereby certifies that

**ASHUTOSH KUMAR SRIVASTAVA**

has successfully completed the 40 hours

Auditor / Lead Auditor Training Course which meets the training requirements of the Exemplar Global and has been declared as competent in the following competency units

- EnMS: Energy Management System
- AU: Management Systems Auditing
- TL: Leading Management Systems Audit Teams

**ISO 50001:2018**

Issue Date: 12<sup>th</sup> Sep. 2022

Certificate Number : 2209123622030102

Authorised Signatory  
(Praggyesh Singh)

This course is certified by Exemplar Global vide registration number TN001

*Note: The course conforms to the principles and practices outlined in the ISO 50001:2018 standard for compliance with standards. This certificate remains valid only if the TNV (The National Veritas) certificate is recognized by Exemplar Global. For a complete list of standards, please write to Mail: info@isoinc.com*

Zoom



## *Certificate of Training*

TNV hereby certifies that

**ASHUTOSH KUMAR SRIVASTAVA**

Has successfully completed the 40 hours

Auditor / Lead Auditor Training Course which meets the training requirements of the Exemplar Global and has been declared as competent in the following competency units

- OH: Occupational Health and Safety
- AU: Management Systems Auditing
- TL: Leading Management Systems Audit Teams

**ISO 45001:2018**

Issue Date: 28<sup>th</sup> Sep. 2021

Certificate Number : 2109281221030101

Authorised Signatory  
(Pragya Singh)

This course is certified by Exemplar Global vide registration number TN006087

*Note: The course conforms to the principles and practice of audit of Management Systems for compliance with standards. This certificate remains the property of TNV and this certificate is recognized by Exemplar Global. For verification of this certificate, please write to Mail: [info@isoindia.org](mailto:info@isoindia.org)*

## CERTIFICATE OF AWARENESS

This certificate is awarded to

**ASHUTOSH KUMAR SRIVASTAVA**

for participating in the eLearning capsule course on

*An Overview of ISO/IEC 17020:2012 for Inspection Bodies*

organized by

Training and Capacity Building (TCB) Cell, Quality Council of India

on

04 June 2022

**Alok Jain**  
Director & Head, TCB

Cert No. TCB/QCI/040622/03-001

**QUEST<sup>®</sup>** (An eLearning Platform of TCB)  
Quality. Credibility. All India.

## CERTIFICATE OF PARTICIPATION

This certificate is awarded to

**ASHUTOSH KUMAR SRIVASTAVA**

for participating in the Virtual Training on

*Requirements of ISO/IEC 17020:2012 for Inspection Bodies*

organized by

Training and Capacity Building (TCB) Cell, Quality Council of India

on

28-29 December 2022



**Alok Jain**  
Director & Head, TCB

Cert No. TCB/QCI/291222/05-008

**QUEST** (An eLearning Platform of TCB)



# Certificate of Training

TNV hereby certifies that

**ASHUTOSH KUMAR SRIVASTAVA**

Has successfully completed the 40 hours

Auditor / Lead Auditor Training Course which meets the training requirements of the Exemplar Global and has been declared as competent in the following competency units

- OH: Occupational Health and Safety
- AU: Management Systems Auditing
- TL: Leading Management Systems Audit Teams

**ISO 45001:2018**

Issue Date: 28<sup>th</sup> Sep. 2021

Certificate Number : 2109281221030101

Authorised Signatory  
(Pragyesh Singh)

**This course is certified by Exemplar Global vide registration number: TN006000**

*Note: The course conforms to the principles and practice of quality of Management Systems for compliance with standards. This certificate remains the property of TNV. For this certificate is recognized by Exemplar Global. For verification of this certificate, please write to Mail: [info@isoindia.org](mailto:info@isoindia.org)*

isplay



## *Certificate of Training*

TNV hereby certifies that

**ASHUTOSH KUMAR SRIVASTAVA**

has successfully completed the 40 hours

Auditor / Lead Auditor Training Course which meets the training requirements of the Exemplar Global and has been declared as competent in the following competency units

- EM: Environmental Management System
- AU: Management Systems Auditing
- TL: Leading Management Systems Audit Teams

**ISO 14001:2015**

Issue Date: 28<sup>th</sup> Sep. 2021

Certificate Number : 2109280721030101

Authorised Signatory  
(Pragyesh Singh)

**This course is certified by Exemplar Global vide registration number TN006000**

*Note: The course conforms to the principles and practical needs of Management Systems for compliance with standards. This certificate remains the property of TNV. If this certificate is recognized by Exemplar Global. For verification of this certificate, please write to Mail: [info@asnindia.org](mailto:info@asnindia.org)*



# *Certificate of Training*

TNV hereby certifies that

**ASHUTOSH KUMAR SRIVASTAVA**

has successfully completed the 5 days

Auditor / Lead Auditor Training Course which meets the training requirements of the Exemplar Global and has been declared as competent in the following competency units

- QM: Quality Management System
- AU: Management Systems Auditing
- TL: Leading Management Systems Audit Teams

**ISO 9001:2015**

Issue Date: 28<sup>th</sup> Jul. 2021

Training Date: 14<sup>th</sup> to 18<sup>th</sup> Jul. 2021

Certificate Number : 2107280221020102

Authorised Signatory  
(Pragya Singh)

**This course is certified by Exemplar Global vide registration number TN001**

*Note: The course conforms to the principles and practices of ISO 9001:2015 for compliance with standards. This certificate is recognized by Exemplar Global and is valid for 5 years. For more information, please write to Mail: info@exemplarglobal.com*



Confederation of Indian Industry  
125 Years - Since 1895

This is to certify that

**A K SRIVASTAVA**

is a

**CII Certified Expert in Sustainable Waste Management**

**K S Venkatagiri**  
Executive Director  
CII-Godrej GBC

**Pradeep Bhargava**  
Chairman  
Environment & Recycling Council

**Hussain Shah**  
Chairman  
GreenCo Education



Issued by CII Sohrabji Godrej Green Business Centre

Issued on 11 July 2020

CIIGBC-SWM-0720-008



Confederation of Indian Industry

This is to certify that

**A K SRIVASTAVA**

is a

**CII Certified Resource  
Efficiency and Environmental  
Sustainability Auditor**

**K S Venkatagiri**

Executive Director  
CII-Greentech Council

**Pradeep Bhargava**

Chairman  
CII-Greentech Council



-Learning



Indian Green Building Council  
C/o. Confederation of Indian Industry  
CII - Sohrabji Godrej Green Business Centre  
Survey No 84, Kothaguda Post, NearHITEC City  
R R District, Hyderabad - 500084  
Tel: 91-40-44185111 Fax: 91-40-44185189  
Email: [igbc@cii.in](mailto:igbc@cii.in)  
Website: [www.greenbusinesscentre.com](http://www.greenbusinesscentre.com) ;  
[www.igbc.in](http://www.igbc.in)

V Suresh  
Chairman

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr Ashutosh Kumar Srivastava** is one of the Individual Members of Indian Green

Building Council (IGBC) for the Year Jan 2020 to Dec 2024.

Mr Ashutosh Kumar Srivastava membership number is "IGBC - IM - 10500131".



V Suresh



Confederation of Indian Industry  
125 Years: 1895-2020

This is to certify that

**ASHUTOSH KUMAR SRIVASTAVA**

is a

**CII Certified Expert in  
Climate Change &  
Environmental Sustainability**

**K S Venkatagiri**

Executive Director  
CII-Godrej IGBC

**Pradeep Bhargava**

Chairman  
Environment & Recycling Council

**Hussain Shariyari**

Chairman  
GreenCo Education Committee



Issued by CII-Schubert Godrej Green Business Centre

Issued on 10 June 2020

CIIIGBCCECCES0420258



Confederation of Indian Industry

## The Indian Green Building Council

hereby certifies that

**Ashutosh Kumar Srivastava**

has successfully demonstrated knowledge on the Green Building Design & Construction, Building Standards & Codes, IGBC Resources & Processes and Green Design Strategies & their Impacts, required to be awarded the title of

## IGBC Accredited Professional

**K S Venkatagiri**  
Executive Director  
CII-Godrej GBC

9562

**V Suresh**  
Chairman  
Indian Green Building Council

06 June 2020

**Gurmit Singh**  
Vice-Chairman  
Indian Green Building Council

# Certificate of Registration



This is to certify that Occupational Health & Safety Management System of

## GC Consultancy Services

Flat No. 614, Vasant Enclave, Rajender Nagar, Gorakhnath,  
Gorakhpur-273015 India

is in accordance with the requirements of the following standard

### ISO 45001:2018

(Occupational Health & Safety Management System)

## SCOPE

Conducting Environmental audits in coordination with CII Green Co Certifications  
which includes Energy, Renewable Energy, Water Conservation,  
Waste Water Management, Life Cycle Assessment

Certificate Number : SCK/03/GCC/22/91/1847

To verify certificate, visit at :

[www.sckcerts.com](http://www.sckcerts.com)

[www.iafcertsearch.org](http://www.iafcertsearch.org)

Initial Registration Date : 20-Jul-2022

1<sup>st</sup> Surveillance Date : 20-Jun-2023

2<sup>nd</sup> Surveillance Date : 20-Jun-2024

Certificate Expiry Date : 19-Jul-2025

Issued by SCK Certifications Pvt. Ltd.

*Adish Gupta*  
Director



Accreditation Board : 3090, Saburn Street, Suite 100, Brea, California 92821-1732, USA

This certificate remains the property of SCK and must be returned to SCK on Cancellation or Suspension of the certificate. Validity of the certificate is subject to successful completion of surveillance audits. Further details regarding the scope of the certificate and the applicability of standard may be obtained by consulting the Organization or [info@sckcerts.com](mailto:info@sckcerts.com)

# Certificate of Registration



This is to certify that Environmental Management System of

## GC Consultancy Services

Flat No. 614, Vasant Enclave, Rajender Nagar, Gorakhnath,  
Gorakhpur-273015 India

is in accordance with the requirements of the following standard

### ISO 14001:2015

(Environmental Management System)

## SCOPE

Conducting Environmental audits in coordination with CII Green Co Certifications  
which includes Energy, Renewable Energy, Water Conservation,  
Waste Water Management, Life Cycle Assessment

Certificate Number : SCK/02/GCC/22/911846

To verify certificate, visit at :

[www.sckcerts.com](http://www.sckcerts.com)  
[www.iafcertsearch.org](http://www.iafcertsearch.org)

Initial Registration Date : 20-Jul-2022  
1<sup>st</sup> Surveillance Date : 20-Jun-2023  
2<sup>nd</sup> Surveillance Date : 20-Jun-2024  
Certificate Expiry Date : 19-Jul-2025

Issued by SCK Certifications Pvt. Ltd.

*Aditya K. P.*  
Director



Accreditation Board : 3090, Saturn Street, Suite 100, Brea, California 92821-1732, USA

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# Certificate of Registration



This is to certify that Quality Management System of

## GC Consultancy Services

Flat No. 614, Vasant Enclave, Rajender Nagar, Gorakhnath,  
Gorakhpur-273015 India

is in accordance with the requirements of the following standard

## ISO 9001:2015

(Quality Management System)

### SCOPE

Conducting Environmental audits in coordination with CII Green Co Certifications  
which includes Energy, Renewable Energy, Water Conservation,  
Waste Water Management, Life Cycle Assessment

Certificate Number : SCK/01GCC/22/911845

Initial Registration Date : 20-Jul-2022  
1<sup>st</sup> Surveillance Date : 20-Jun-2023  
2<sup>nd</sup> Surveillance Date : 20-Jun-2024  
Certificate Expiry Date : 19-Jul-2025

To verify certificate visit at:

[www.sckcerts.com](http://www.sckcerts.com)  
[www.iafcertsearch.org](http://www.iafcertsearch.org)

Issued by SCK Certifications Pvt. Ltd.

*Aditya K. S.*  
Director



Accreditation Board : 3080, Saturn Street, Suite 100, Brea, California 92821-1732, USA

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# राष्ट्रीय लघु उद्योग निगम लिमिटेड THE NATIONAL SMALL INDUSTRIES CORPORATION LIMITED

(A Government of India Enterprise)

Ss. No. K/187385

Branch Office : NSIC Limited, 112/1, 11nd Floor, Benajhabar Road, Kanpur-208 002

Ph : 0512-2535049

Fax : 0512-2543217

Email : bokan@nsic.co.in

Website : www.nsic.co.in

## STORE DETAILS CERTIFICATE

Amendment Certificate Certificate (Valid From 18/10/2022 to 17/10/2023)

ANNEXURE TO GOVERNMENT PURCHASES ENLISTMENT CERTIFICATE

NO. NSIC/GP/KAN/2022/0050413 D.T. 05/12/2022

ISSUED TO : M/s. G C Consultancy Services, UTTAR PRADESH

Flat No 614, Vasant Enclave, Rajender Nagar, Lacchipur,, GORAKHPUR, UTTAR PRADESH-273015

| Sno | Name of Service/ Activities | Definition of Activity/ Service(s)                                                                  | Quantitative Capacity/Services PMPS |
|-----|-----------------------------|-----------------------------------------------------------------------------------------------------|-------------------------------------|
| 1   | ENVIRONMENTAL CONSULTANCY   | RENEWABLE ENERGY<br>ENERGY<br>WATER CONSERVATION<br>WATER WASTE MANAGEMENT<br>LIFE CYCLE ASSESSMENT | Rs.5 LAKH                           |

CHECKED BY

S.N. YADAV

M/s. G C Consultancy Services



Authorized Branch Manager  
NSIC LTD.  
112/1, 11nd Floor, Benajhabar Road, Kanpur  
Authorized Signatory

\*Authenticity of the certificate can be checked through the web portal: [www.nsicspronline.com](http://www.nsicspronline.com)



CIN : U74140DL1955G01002481



# राष्ट्रीय लघु उद्योग निगम लिमिटेड THE NATIONAL SMALL INDUSTRIES CORPORATION LIMITED

(A Government of India Enterprise)

S.No. KAN-0002870  
Sr. No. 123061

Branch Office : NSIC Limited, 112/1, 11nd Floor, Benajhabar Road, Kanpur-208 002

Ph : 0512-2535049

Fax : 0512-2543217

Email : bakan@nsic.co.in

Website : www.nsic.co.in

## GOVERNMENT PURCHASE ENLISTMENT CERTIFICATE

Amendment Certificate Certificate (Valid From 18/10/2022 to 17/10/2023)

Ref.No NSIC/GP/KAN/2022/93853

Date: 05/12/2022

M/s. G C Consultancy Services  
FLAT No-614, VASANT ENCLAVE, RAJENDRA  
NAGAR,  
GORAKHPUR,  
UTTAR PRADESH- 273015

Factory Address:

1, Flat No. 614, Vasant Enclave, Rajender Nagar,  
Lacchipur,  
GORAKHPUR, UTTAR PRADESH -273015

Name of the Proprietor

ASHUTOSH KUMAR SRIVASTAVA

Constitution:

Proprietorship

Udyam Registration

Number UDYAM-UP-32-

0023384

Enterprise Social Class:

GENERAL

Special Category:

GENERAL

GOVERNMENT PURCHASE REGISTRATION NO: NSIC/GP/KAN/2022/0050413

Monetary Limit: ₹ 5 lakhs ( ₹ Five Lakh Only)

MSEs registered with NSIC are exempted from deposit of Earnest Money irrespective of value of Monetary Limit.  
Your name has been registered as a MSE Unit eligible for participation in the Central Government Store  
Purchase Programme as per the Single Point Registration Scheme for the following  
Item(s)/Store(s)/Service(s).

| Name of the Store(s)/<br>Service(s) | Specification(s) | Qualitative Capacity | Quantitative Capacity<br>P.M.P.S. |
|-------------------------------------|------------------|----------------------|-----------------------------------|
|-------------------------------------|------------------|----------------------|-----------------------------------|

"As per List Attached" (1 Item only )

**Disclaimer:-**1. The purchasing agencies are advised to satisfy themselves with the store details in the certificate while doing the Technical Evaluation stage before placing the tender/order on the units, certified by NSIC.

2. This certificate will be valid subject to compliance of definition (Composite criteria of investment and turnover for classification of Micro, Small Enterprises as per MSMED Act).



*(Signature)*  
Authorized Signatory  
Branch Manager  
NSIC Ltd.  
112/1, 11nd Floor, Benajhabar Road, Kanpur

M/s. G C Consultancy Services

"Authenticity of the certificate can be checked through the web portal: [www.nsicsonline.com](http://www.nsicsonline.com)"



CIN : U74140DI1955GOI002481

Conditions overleaf



भारत सरकार  
Government of India  
सूक्ष्म, लघु एवं मध्यम उद्यम मंत्रालय  
Ministry of Micro, Small and Medium Enterprises



## UDYAM REGISTRATION CERTIFICATE

UDYAM REGISTRATION NUMBER **UDYAM-UP-32-0023384**  
NAME OF ENTERPRISE **G C CONSULTANCY SERVICES**  
TYPE OF ENTERPRISE \* **MICRO ( Based on FY 2020-21 )**

MAJOR ACTIVITY

**SERVICES**

SOCIAL CATEGORY OF ENTREPRENEUR

**GENERAL**

NAME OF UNIT(S)

| S.No. | Name of Unit(s)          |
|-------|--------------------------|
| 1     | G C Consultancy Services |

OFFICIAL ADDRESS OF ENTERPRISE

|                     |                |                            |                       |
|---------------------|----------------|----------------------------|-----------------------|
| Flat/Door/Block No. | 614            | Name of Premises/ Building | Vasant Enclave        |
| Village/Town        | GORAKHPUR      | Block                      | GORAKHPUR             |
| Road/Street/Lane    | Rajender Nagar | City                       | GORAKHPUR             |
| State               | UTTAR PRADESH  | District                   | GORAKHPUR, Pin 273015 |
| Mobile              | 7087794292     | Email:                     | gcco6114@gmail.com    |

DATE OF INCORPORATION / REGISTRATION OF ENTERPRISE

26/02/2022

DATE OF COMMENCEMENT OF PRODUCTION/BUSINESS

26/02/2022

NATIONAL INDUSTRY CLASSIFICATION CODE(S)

| S.No. | NIC 2 Digit                         | NIC 4 Digit                                        | NIC 5 Digit                                         | Activity |
|-------|-------------------------------------|----------------------------------------------------|-----------------------------------------------------|----------|
| 1     | 63 - Information service activities | 6399 - Other information service activities n.e.c. | 63999 - Other information service activities n.e.c. | Services |

DATE OF UDYAM REGISTRATION

08/11/2022

\* In case of graduation (upward/downward) of status of an enterprise, the benefit of the Government Schemes will be availed as per the provisions of Notification No. S.O. 2119(E) dated 26.06.2020 issued by the M/o MSME.

Disclaimer: This is computer generated statement, no signature required. Printed from <https://udyamregistration.gov.in> & Date of printing:- 08/11/2022

For any assistance, you may contact:

1. District Industries Centre: GORAKHPUR ( UTTAR PRADESH )
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