Table 2. Sustainability evaluation framework of underground space planning

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| Dimension | Indicator items | Coding items | Note | Explanation |
| 1 Information base | 1.1 Location identification | 1.1.1 Planning scope \* |  | Planning boundary and planning area. This item shall be included in the general provisions |
| 1.1.2 Planning depth \* |  | Planned vertical depth. This item shall be included in the general provisions |
| 1.2 Development status of underground space. | 1.2.1 Development history of underground space |  | Description of the time course and current stage of underground space development in the planning area |
| 1.2.2 Developed scale of underground space | Quantity and area (total) | The total amount of underground space developed in the planning area, including quantity and area |
| 1.2.3 Function type distribution and scale |  | Functional types of the developed underground space in the planning area and the area of each type of underground space |
| 1.2.4 Summary of underground space development |  | Summarize the current situation and existing problems of underground space development in the planning area |
| 1.2.5 Annual growth of underground space \* |  | Development area of annual growth of underground space in the planning area |
| 1.3 Engineering geological conditions | 1.3.1 Landform |  | Overall characteristics of landform, terrain height, river and lake distribution, etc., in the planning area- |
| 1.3.2 Geotechnical engineering geology |  | Stratum, rock soil, and geological structure of the planning area |
| 1.3.3 Hydrogeological conditions |  | Groundwater type, aquifer, and distribution in the planning area |
| 1.3.4 Site stability evaluation | Including geological hazards | The possibility of geological disasters, such as landslide and collapse, in the planning area and the distribution of seismic fault zones |
| 1.4 Ecological environment | 1.4.1 Ecologically sensitive area \* |  | Areas within the planning area that are vulnerable to negative ecological effects caused by development activities |
| 1.4.2 Important nature reserves \* |  | The designated important nature reserves within the planning area |
| 1.4.3 Important water conservation areas \* |  | The designated important water source protection areas within the planning area |
| 1.5 Construction situation | 1.5.1 Surface construction |  | Development land area, developed area, and growth of construction land in the planning area |
| 1.5.2 Underground buried objects | Historical relics and historic sites | Description of cultural relics and other buried objects in the planning area that may affect the development of underground space |
| 1.5.3 Underground development control zoning \* | Prohibited construction, conditional construction, suitable construction, etc. | The current underground development control zoning in the planning area |
| 1.6 Development value | 1.6.1 Geographic conditions |  | Geographical location, regional connection and economic development of the planning area. |
| 1.6.2 Population distribution |  | Population size, population structure and distribution in the planning area. |
| 1.6.3 Rail transit network |  | Current rail transit lines and operation conditions in the planning area. |
| 1.6.4 Surface land use |  | The land use mode of the ground space in the planning area and the proportion of various land uses. |
| 1.7 Capacity evaluation | 1.7.1 Planning basis list \* |  | List the plans, standards and specifications for underground space planning. |
| 1.7.2 Current planning evaluation |  | Evaluate the implementation of the current underground space planning in the planning area. |
| 1.7.3 Financial capacity (investment budget) |  | Financial capacity of local government and budget available for underground space construction. |
| 2 Vision and goals | 2.1 Planning vision | 2.1.1 Meet the overall urban development goals |  | The vision of underground space planning is coupled with the overall development goal of the city. |
| 2.1.2 Sustainability (resilience) |  | The vision description of underground space development on environmental protection, improving land use efficiency and promoting sustainable development. |
| 2.1.3 Integrity (coordination with ground planning) |  | Vision description of coordination between underground space and ground space planning. |
| 2.2 Planning goals and indicators | 2.2.1 Economic goals |  | The goal of promoting economic growth and improve the quality and efficiency of economic development. |
| 2.2.2 Function goals |  | The goal of underground space planning to improve urban functions. |
| 2.2.3 Transportation goals |  | The goal of the construction and improvement of road and traffic facilities. |
| 2.2.4 Safety goals |  | The goal of comprehensive disaster prevention and urban security. |
| 2.2.5 Environmental goals |  | The goal of protecting and improving urban ecological environment. |
| 2.2.6 Public facility goals |  | The goal of the construction and improvement of public service facilities. |
| 3 Strategies | 3.1 Demand prediction | 3.1.1 Ecological capacity \* |  | The maximum underground space development capacity supported by the natural ecological conditions of the planning area |
| 3.1.2 Functional requirement |  | The underground space in the planning area needs to be added, transformed and improved. |
| 3.1.3 Scale demand |  | Prediction of the required scale of underground space at the end of the planning period. |
| 3.1.4 Space layout requirements |  | Underground space layout structure and main development direction. |
| 3.2 Rationality of planning layout | 3.2.1 Rationality of plane function |  | Overall layout mode and principle of underground space |
| 3.2.2 Rationality of vertical stratification |  | Vertical level division of underground space and functional layout of each level. |
| 3.2.3 Rationality of development scale |  | Reasonable estimation of the development scale of various functions of underground space. |
| 3.2.4 Rationality of system functional requirements |  | Rationality demonstration of each system function of underground space. |
| 3.2.5 Conformity of underground and above-ground functions |  | Demonstration of the reasonable complementary relationship between the above ground and underground space functions. |
| 3.3 System planning integrity | 3.3.1 Public service facilities |  | Space planning and layout strategy of underground administrative office, cultural and sports, medical, educational and other facilities. |
| 3.3.2 Commercial facilities |  | The functional positioning, spatial planning, layout strategy and format setting of underground commercial facilities. |
| 3.3.3 Transportation facilities | Rail transit facilities, underground road facilities, underground parking facilities | Space planning, layout strategy and connection of underground rail transit, road, parking and pedestrian systems. |
| 3.3.4 Municipal facilities |  | Space planning and layout strategy of underground municipal stations, pipelines and pipe galleries. |
| 3.3.5 Civil air defense facilities |  | Space planning and construction standards for underground civil air defense facilities. |
| 3.4 Planning control and guidance | 3.4.1 Facility planning and avoidance |  | The principle of overall layout of various underground facilities and the principle of avoidance between facilities. |
| 3.4.2 Development depth control |  | Vertical layer division and depth control of underground space. |
| 3.4.3 Planning guidance for key areas |  | Scope, function positioning, development strategy and design guidance of key areas for underground space development. |
| 3.4.4 Interconnection | Connectivity with surrounding buildings, connectivity with ground space, platform, and transfer organization (rail transit), access control | The connection mode and design guidelines between underground space and ground space and buildings. |
| 3.5 Comprehensive disaster prevention | 3.5.1 Fire control |  | Fire risk analysis, preventive measures and design guidelines. |
| 3.5.2 Flood control |  | Flood risk analysis, preventive measures and design guidelines . |
| 3.5.3 Anti-seismic |  | Guidelines for seismic fortification intensity and seismic structure design. |
| 3.5.4 Emergency evacuation |  | Underground space as refuge. |
| 3.6 Environmental safety | 3.6.1 Open space |  | Open space layout and design guidelines. |
| 3.6.2 Underground lighting shaft and ventilation shaft |  | Layout of lighting shaft and ventilation shaft in underground space. |
| 3.6.3 Underground air quality |  | Control index and measures for air quality. |
| 3.6.4 Underground auditory environment |  | Control index and measures of noise. |
| 3.6.5 Underground temperature and humidity control |  | Control index and measures of temperature and humidity. |
| 3.6.6 Underground human environment |  | Humanistic landscape and humanized design guidance. |
| 3.6.7 Environmental impact assessment |  | Possible impact of underground space construction on ecological environment. |
| 3.7 Capability of reaction to changes | 3.7.1 Transition between peacetime and wartime |  | Strategies and models for the comprehensive utilization of underground space between peacetime and wartime. |
| 3.7.2 Reserve elastic space |  | Flexible space reserved for future changes. |
| 3.8 Economic benefits | 3.8.1 Investment cost calculation |  | Calculation of investment cost for underground space development. |
| 3.8.2 Operation investment and financing mode |  | Description of project investment and financing mode and operation mode. |
| 3.8.3 Ownership management mode |  | Description of ownership and management mode of underground space. |
| 4 Planning implementation | 4.1 Planning implementation strategies | 4.1.1 Project list \* |  | List the major underground space development and construction projects planned to be implemented in the planning period. |
| 4.1.2 Division of labor and responsibilities |  | The division of labor for underground space construction and the work of each part are mainly responsible for the organization, department and personnel. |
| 4.1.3 Development schedule |  | The short-term and long-term time division of the plan and the development objectives, priorities and tasks of each stage. |
| 4.1.4 Source of funds |  | Source of funds for project construction |
| 4.1.5 Planning implementation guarantee |  | Relevant laws, regulations, technical specifications and operation mechanisms to ensure the implementation of the plan. |
| 4.2 Implementation monitoring | 4.2.1 Completion measure |  | Indicators to measure the progress of project construction. |
| 4.2.2 Operation measurement indicators |  | Indicators to measure the operation level after the completion of project construction. |
| 4.2.3 Responsibility implementation |  | Units, departments or individuals responsible during and after the construction of the project. |
| 4.3 Planning update | 4.3.1 Planning update conditions |  | Description of the conditions for revising the plan or carrying out a new round of planning. |
| 4.3.2 Planning system |  | Description of the system and mechanism of underground space planning. |
| 5 Planning coordination | 5.1 Vertical planning undertaking | 5.1.1 Implement the requirements of superior planning | Are the requirements of upper-level planning summarized? Are there any rigid conduction requirements? Are there any suggestive requirements? | Summarize the upper planning requirements, including rigid conduction requirements and suggestive requirements. |
| 5.1.2 Requirements for undertaking subordinate planning | Whether specific index requirements are put forward for regulatory detailed planning, node design and special professional planning of underground space? | Put forward control indicators and design guidelines for subordinate planning. |
| 5.2 Parallel planning coordination | 5.2.1Description of “parallel-level” planning \* | Is there a description of “parallel level” planning? | Brief description of other important contents and indicators of special planning at the same level. |
| 5.2.2 Coordination with “parallel level” planning | Is there feedback on the requirements of “parallel-level” planning? | Feedback and response to other special planning requirements at the same level. |
| 6 Institutional coordination and public participation | 6.1 Coordination with other agencies | 6.1.1 Within local government |  | Coordination mechanisms and approaches with other government departments outside the local planning department. |
| 6.1.2 With local independent groups and civil society organizations |  | Coordination mechanisms and approaches with local independent groups and non-governmental organizations. |
| 6.1.3 With organizations outside the Administrative Region |  | Coordination mechanism and approach with organizations outside the administrative region related to the implementation of the plan. |
| 6.2 Public participation | 6.2.1 Public opinion solicitation |  | The action of soliciting public opinions and the summary of public opinions at the planning preparation stage. |
| 6.2.2 Planning publicity \* |  | Whether the planning is publicized after completion. |
| 6.2.3 Public feedback on planning supervision |  | Description of the public's supervision mechanism and feedback channels for the implementation of the plan. |

Note: The code items marked with “\*” are assigned binary coding, and the score is 0 or 1. Other coding items are degree coding, and the scores are 0, 1, or 2.