

Research on the Spatial Database Construction of Three-line Industrial Heritage Based on “One Map” of Territorial Space Planning

—A Case Study of Mianyang Two-Bomb City

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Abstract

In the process of promoting the national territorial spatial planning system in all provinces, cities and counties, the geospatial database of “One Map” has realized the information sharing and collaborative work of multiple departments. Based on this, this paper intended to provide a set of standardized mapping models for industrial heritage storage, and through the establishment of the database to protect and reuse the status quo of industrial heritage research. This paper took the third-line construction industrial heritage of Mianyang “Two-Bomb City” as the research object, developed the relevant drawing standards of third-line industrial heritage database, and studied the database construction process. GIS technology is used to establish a geospatial database of the third-line industrial heritage in cooperation with the “One Map” system, in order to provide reference for the storage of the third-line industrial heritage in various places, and to protect and reuse the third-line industrial heritage from the perspectives of spatial factors, planning coordination and dynamic assessment.

Keywords

Third-Line Construction of Industrial Heritage, GIS, Geospatial Database

1. Introduction

The 2018 State Council institutional reform program proposes to no longer retain the Ministry of Land and Resources and to form the Ministry of Natural Resources. The newly formed Ministry of Natural Resources integrates the rele-

vant responsibilities of the former Ministry of Land and Resources, the former State Oceanic Administration, the former State Bureau of Mapping and Geographic Information, the National Development and Reform Commission, the Ministry of Housing and Urban-Rural Development, the Ministry of Water Resources, the Ministry of Agriculture and the former State Forestry Administration. In 2019, the twelfth meeting of the Standing Committee of the thirteenth National People's Congress considered and adopted the amendment to the Land Management Law of the People's Republic of China, adding Article 18: The State establishes. The spatial planning system of the national land. The spatial planning of the national land approved by law is the basic basis for all kinds of development, protection and construction activities. In order to grasp the status of resources in the region and to supervise resource data scientifically and efficiently with information technology, the Ministry of Land has proposed a basic definition of "one map" of the national land. It is to integrate remote sensing information, land use status, basic farmland data, mineral data, change information and basic geographic data. As a result, the core database of "one map" is formed by combining heterogeneous data from different categories and specialties according to the unified database construction standard and logical concentration principle, which is the key step to realize the full-coverage supervision and management of land resources [1].

In 2021, the Ministry of Natural Resources and the State Administration of Cultural Heritage, in order to fully implement the instructions of the CPC Central Committee and The State Council on strengthening the protection of historical and cultural heritage and incorporating the protection and management of cultural relics into the formulation and implementation of territorial spatial planning, The Guiding Opinions on Strengthening the Protection and Administration of Historical and Cultural Heritage in the Formulation and Implementation of the National Territorial Space Plan (hereinafter referred to as the Opinions) were jointly issued. Future spatial information on historical and cultural heritage will be incorporated into the platform, according to the guideline. On the basis of the third National Land Survey and the third National Survey of cultural relics, local administrative departments of cultural relics and natural resources, together with the administrative departments of natural resources, should further carry out special and special investigations of cultural relics and resources, and timely incorporate spatial information of cultural relics into the platforms at the same level in accordance with the data standards of the National Land and Space Basic Information Platform and in combination with the establishment of a database of historical and cultural heritage resources. Establish data sharing and dynamic maintenance mechanism. The guideline also points out that historical and cultural protection lines should be drawn in the overall plans of cities, counties and towns, and included in the "one map" of territorial space planning.

As an important part of the historical and cultural heritage, the industrial her-

itage of the Third Line is a “cultural treasure” that needs to be excavated. As a part of the social and industrial history since the founding of the People’s Republic of China, its important historical value is evident. As a symbol of urban culture and urban spirit, the important social value of the “Third Line People” is outstanding. The magnificent and special architectural aesthetic value of the third-line buildings, represented by the “816 Cave Project”, is a testimony to the human wisdom of the “third-line builders” in conquering nature. Therefore, the establishment of a database of the industrial heritage of the third line construction and its all-round and dynamic management and protection research are the urgent tasks to be carried out by the historical and cultural heritage protection units nationwide.

2. Overview of the Industrial Heritage of the Two-Bomb City and Three Lines

2.1. Basic Introduction of Two-Bomb City

China Two-Bomb City, built in the 1960s, was originally the site of the former headquarters of the Ninth Academy (Chinese Academy of Engineering Physics), China’s second headquarters for nuclear weapons development. The institute moved here in 1969 and has been based here for 23 years. During these 23 years, as many as 29 nuclear tests were completed here. In the Two-Bomb City, Yu Min, Wang Jianchang, Deng Jiaxian, Zhu Guangya, Chen Nengkuan, Zhou Guangzhao, Cheng Kaijia and other outstanding “Two Bombs and One Star” medal winners were born, and generals such as Zhang Aiping and Li Jue have left their footprints here. So far, the archives, auditorium, office building, model hall, Deng Jiaxian’s old residence, intelligence center, general building and other buildings in the 1960s and the national soul monument forest, air-raid shelter and many other commemorative objects are still intact, and in the third national cultural relics census, it was listed among the top 100 new discoveries of cultural relics in China.

2.2. Status of the Location of Two-Bomb City

It is located at the foot of Changqing Mountain on the western outskirts of Zitong County, Mianyang City, Sichuan Province, across the river from Zitong County; it is about 3 kilometers from Zitong County and about 45 kilometers from Mianyang City. It starts from Tongjiang River in the east, reaches Hejiawan in the west, faces Changqing Mountain in the south and leans on Xijigou in the north. Changqing Mountain is the high point of the site, which is descended slowly by multi-level platforms (**Figure 1**).

2.3. Two-Bomb City and Three Lines of Industrial Heritage Situation

2.3.1. Third Line Industrial Heritage Composition

Third-line industrial heritage can be divided into tangible heritage and intangible heritage. The material form of the third line industrial heritage mainly consists

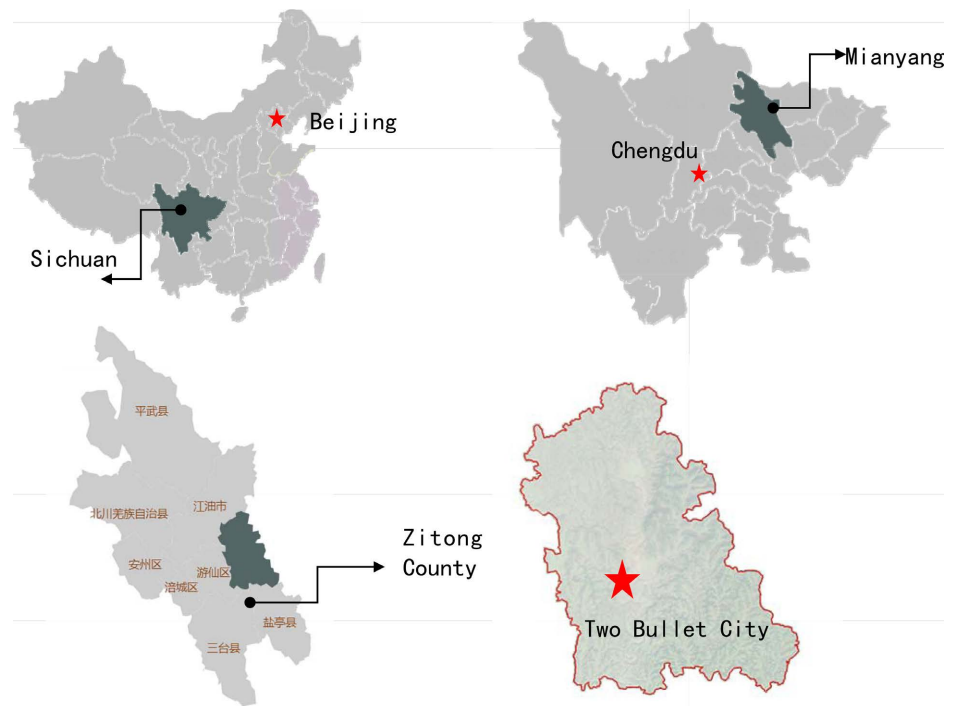


Figure 1. Two-Bomb City in the urban area (Source: Self-drawn by the author).

of single facilities and environmental elements, etc. The single facilities are divided into buildings, structures, equipment and equipment, *i.e.* various industrial plant buildings, industrial special auxiliary buildings and industrial professional service buildings, industrial production equipment, industrial storage equipment, transportation equipment, production structures, auxiliary or related structures; the environment mainly consists of natural and artificial environments, *i.e.* lakes. The environment is mainly composed of natural and artificial environments, *i.e.* lakes, rivers and other natural environments and artificial environments such as production and operation sites and transportation corridors. The non-material aspect includes the skills of the three lines of industrial production as well as the culture and spirit of related celebrities.

2.3.2. Third-Line Industrial Heritage Buildings

After the field survey, the whole area of the Two-Bomb City is divided into four sections: “production area, living area, administrative office area, and special area”. The scale of the remaining buildings is huge. There are 81 surviving buildings with a construction area of about 51,900 square meters. Including 41 buildings in the living area, with a construction area of about 28,100 square meters, the main buildings include the welcome building, fusion hall, etc.; 23 buildings in the administrative office area, with a construction area of about 18,600 square meters, the main buildings include the auditorium, library, the former residence of Wang Jianchang, the former residence of Chen Nengkuan, the former residence of Deng Jiaxian and Li Yingjie, the general building, the two bombs course museum, etc.; 17 buildings in the production area, with a construc-

tion area of about 0.52 million m², the main buildings are printing factory, small car class, etc. The special area is an air-raid shelter of nearly 1 km (Figure 2).

3. Construction of the Database of Industrial Heritage of Two-Bomb City and Three Lines Based on “One Map”

3.1. Database Construction Principles

3.1.1. Standardization Principle

The information on paper files, network information and on-site research situation is sorted out, supplemented and improved to form a standardized collation result including graphics, attributes and other contents. Referring to the Specification of Municipal Territorial Spatial Master Plan Database and taking into account the local situation of Mianyang City, the database of the third-line industrial heritage was organized and extended [2].

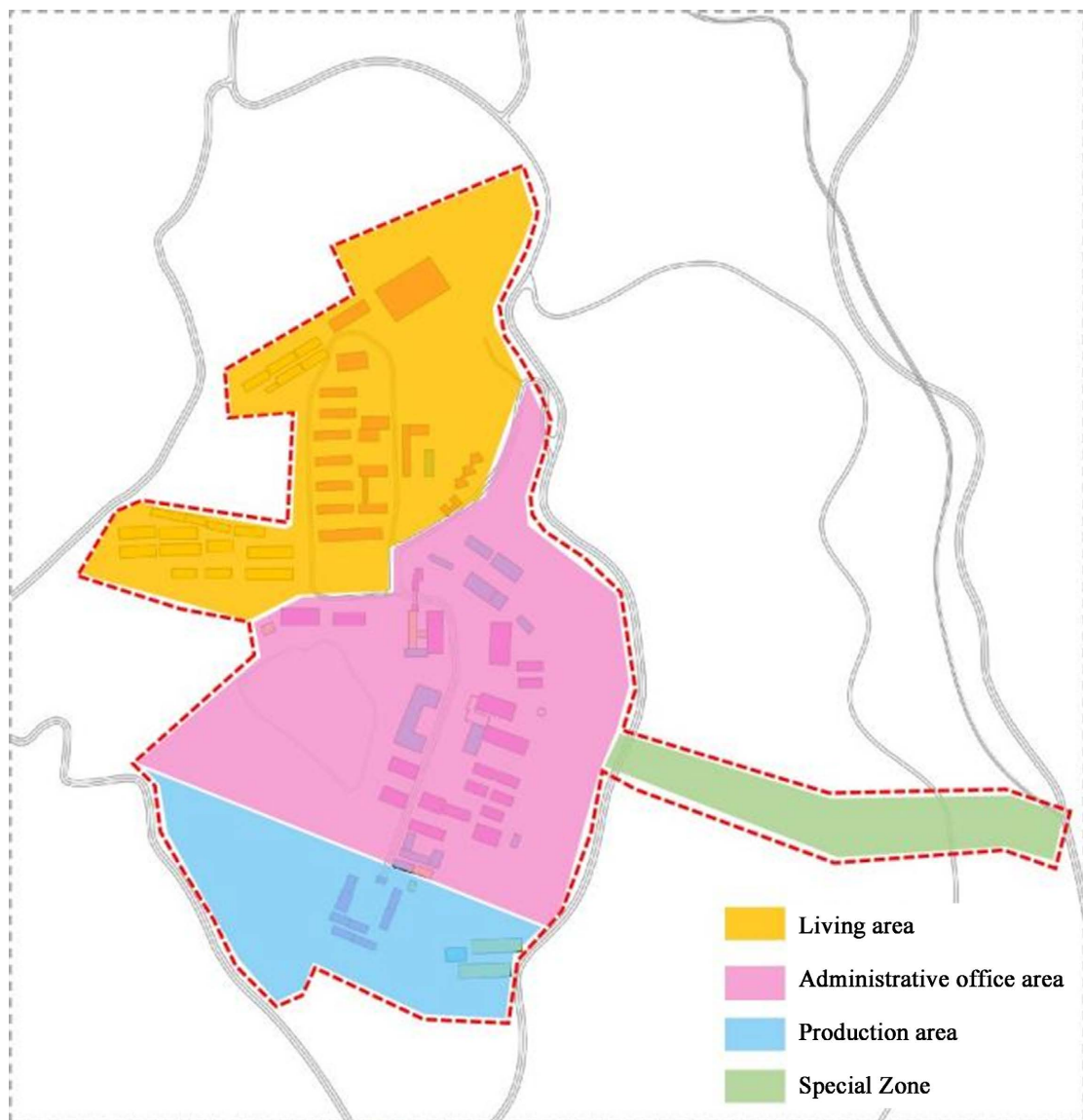


Figure 2. Zoning Map of Two-Bomb City (Source: Self-drawn by the author).

3.1.2. Integrity Principle

The requirements of the result database should be summarized and generalized, and in the process of database construction, it should be constructed according to the relevant specifications and contain all the information that meets the criteria of the database without missing.

3.1.3. Consistency Principle

The data information must be consistent with that before the database construction. If the original data is verified to be wrong, the data cannot be modified, and need to set up identifiers to record and mark the data to ensure data consistency. Data can be updated in the future.

3.1.4. The Principle of Integration of Graphical Genera

All kinds of spatial data formats and data coordinate systems of the constructed database should be consistent. The descriptions of graphical data and attribute data should correspond to each other, so as to ensure the correct correlation between graphs and genera of data and realize the goal of integrated management and “map management and map search”.

3.2. Data Information Collection

Through literature reading method, on-site research method, questionnaire survey method and Internet information collection method, a research plan was developed to implement the research and information collection. Among them, the information collected includes the original name of the third-line industrial relics, the name after the renewal and utilization, the geographical location (latitude and longitude), the building size, structure, number of floors, quality, renewal and utilization mode, function and protection level of the third-line industrial relics, etc. (Table 1).

Based on the results of multiple studies in the Two-Bomb City, the collected information data were screened and 48 research samples were identified. The data were classified and organized into 3 parts: graphic information, attribute information and hyperlinked subsidiary information, which were summarized to form a comprehensive information set of the third-line industrial heritage of Two-Bomb City.

3.3. Develop Database Construction Standards

According to the “Specification for Municipal Overall Territorial Spatial Planning Database (for Trial Implementation)”, the accession criteria, layer structure and topographic content of the Third Line Industrial Heritage Database are established. In order to refine the elements of the overall territorial spatial planning database, improve the relevance and operability of the database, and provide certain reference significance for the accession of industrial heritage of the Third Line construction around the country.

3.3.1. Mathematical Foundations

The database adopts the “Gauss-Krueger” projection, the national standard

Table 1. Research information table of industrial heritage of Two-Bomb City and three lines.

The original name of the industrial heritage (relics) of the third line construction		
Third-line construction of industrial heritage (remains) after updating the use of the name		
Location	Location	
	Core positioning coordinates	Longitude Latitude
Remaining buildings	Size	
	Structure	
	Number of layers	
	Quality	
	Protection level	
	Function	
Base Environment	Natural Environment	Rivers, mountains, green areas, etc.
	Artificial environment	Roads, squares, open spaces, sports venues, etc.
Update utilization patterns and methods		
Level of cultural heritage protection units		
Intangible Cultural Heritage	Celebrities	
	Spirituality	
	Industrial skills	

zoning, the “2000 National Geodetic Coordinate System” and the “1985 National Elevation Datum”.

3.3.2. Database Structure Definition

The database structure definition should conform to the following basic rules.

- 1) Layer names are named in Chinese characters, generally using the full name, when the name is long, you can use keyword names.
- 2) Attribute table names are named using letters, generally using the first letter of the name hanyu pinyin, and the first letter of the keyword hanyu pinyin when the name is longer. If there is a duplication of attribute table names, adjust one of them.
- 3) The attribute data structure field types are described as Char for character, Float for double precision floating point, and Int for long integer [3].

3.3.3. Layer Content of the “One Map” of the Industrial Heritage of the Third Line

The “One Map” of the industrial heritage of the Third Line contains three layers, which are in one-to-one correspondence with the vector graphics on the gis platform map. Its content is mainly formulated with reference to the “Specification for Municipal Spatial Master Plan Database (for Trial Implementation)” and related historical and cultural heritage protection plans, providing reference and guidance for the third-line database [4] (Table 2).

Table 2. Contents of the “One Map” of the industrial heritage of Two-Bomb City and three lines.

First Level Layer Catalog	Secondary Layer Catalog	Three-level layer catalog
Two-Bomb City and Three Lines Industrial Heritage Preservation Area (Range Line + Satellite Base Map)	Historic Landscape District	River
		Greenfield
		Roads
		Piazza
Two-Bomb City and Three Lines Industrial Heritage Preservation Area (Range Line + Satellite Base Map)	Cultural Heritage Protection Unit	The body of the cultural preservation building
		The scope of cultural preservation protection
		Cultural preservation construction control zone
	Historic Buildings	Historic Building Preservation Object Ontology
		Core protection area of historic buildings
		Historic building construction control zone

3.3.4. Data Specification of Spatial Element Attributes of Third-Line Industrial Heritage

The attributes of the third-line industrial heritage elements are presented in the form of attribute tables for each third-line industrial heritage item. The attribute tables are mainly formulated with reference to the “Specification for Municipal Territorial Spatial Master Plan Database (for Trial Implementation)” as the standard. The types of attribute table can be divided into basic information attribute table, heritage protection unit attribute table and historical building attribute table.

The basic information attribute table includes the element code of the Third Line Industrial Heritage Preservation Area, the administrative district code, the name of the administrative district, the name, the administrative district where it is located, the category, the scope, and the environmental basic information such as rivers and roads.

The attribute table of heritage protection units and historical buildings includes information such as name, location, size, structure, number of floors, area, quality, level, and utilization. Its related spatial elements attribute data specification is shown in the following table (Table 3).

3.4. The Establishment of the Database of Industrial Heritage of Two-Bomb City and Three Lines of Construction

3.4.1. Vector Data Entry

Through GIS, we imported the information of industrial heritage properties of the Two-Bomb City and three lines of construction (Excel table of industrial heritage properties of the Two-Bomb City and three lines of construction), loaded the points of each relic according to their latitude and longitude coordinates, and chose the Beijing 5 - 4 coordinate system when loading the points of each relic.

Table 3. Spatial element attribute data specification of industrial heritage of Two-Bomb City and three lines.

Property Table Name	Field Name	Field Code	Field Type	Field Length	Fractional Digits	Value Range
Basic Information Property Table	Element Code	YS DM	Char	10	/	/
	Administrative District Code	XZ QDM	Char	12	/	/
	Administrative District Name	XZ QMC	Char	100	/	/
	Name	MC	Char	100	/	/
	District	SZ XZQ	Char	2	/	/
	Category	LB	Char	2	/	95 Note ¹
	Scope	FW	Float	2	/	/
Basic Information Property Table	River	HL	Float	15	2	>0 (Unit: meter)
	Roads	DL	Float	15	2	>0 (Unit: meter)
Heritage protection units/historical buildings attribute table	Name	MC	Char	100	/	/
	Location	WZ	Float	15	/	/
	Size	CC	Float	15	2	>0 (Unit: meter)
	Structure	JG	Char	12	/	/
	Number of layers	CS	Float	15	2	>0 (Unit: Layer)
	Area	MJ	Float	15	2	>0 (Unit: square meters)
Heritage protection units/historical buildings attribute table	Quality	ZL	Char	12	/	/
	Level	JB	Char	100	/	10/20/30/40 Note ²
	Utilization	LYQK	Char	100	/	/

¹In the Code Table 29 of the Specification of Municipal Spatial Master Plan Database (for Trial Implementation), 95 is specified as the industrial heritage code. ²Code 10 represents the national key cultural relics protection units, code 20 represents the provincial cultural relics protection units, code 30 represents the city (county) level cultural relics protection units, code 40 represents the general immovable cultural relics points.

3.4.2. Image Data Entry

The map downloader is selected to download the map of Two-Bomb City in Zitong County, Mianyang City. The downloader can automatically generate the latitude and longitude of the 4 vertices of the downloaded map, and when the map is imported into the GIS file, the Cartesian coordinate system coordinates of the 4 corner points will be automatically generated. The Cartesian coordinate system is a planar coordinate system, while the Beijing May 4 coordinate system is an ellipsoidal coordinate system, so the map needs to be converted from a planar to an ellipsoidal coordinate system for projection. The projection conversion tool of GIS (Georeferencing tool-view link table-load) is used to load the plane coordinates of the 4 points to be matched and the latitude and longitude of the 4 corners of the original image to match.

3.4.3. Hyperlinked Data Entry

Hyperlinked data, *i.e.*, the development and evolution history, current status

photos, etc. beyond the project listed in the point property information table formed through the research. The procedure is to store each point as a web page file, with a field in the attribute information statistics table as the storage path of the file. Once the table is imported into the GIS, the web file can be hyperlinked into the GIS by selecting the “Text Image” column as the reference item.

The above steps were completed, and a database of industrial heritage of Two-Bomb City and three lines of construction was established [5] (Figure 3).

4. Use of Two-Bomb City and Three Lines of Industrial Heritage Database

4.1. Realize the Graded and Classified Protection of the Third-Line Industrial Heritage Buildings

According to the spatial analysis function of the GIS database, the spatial

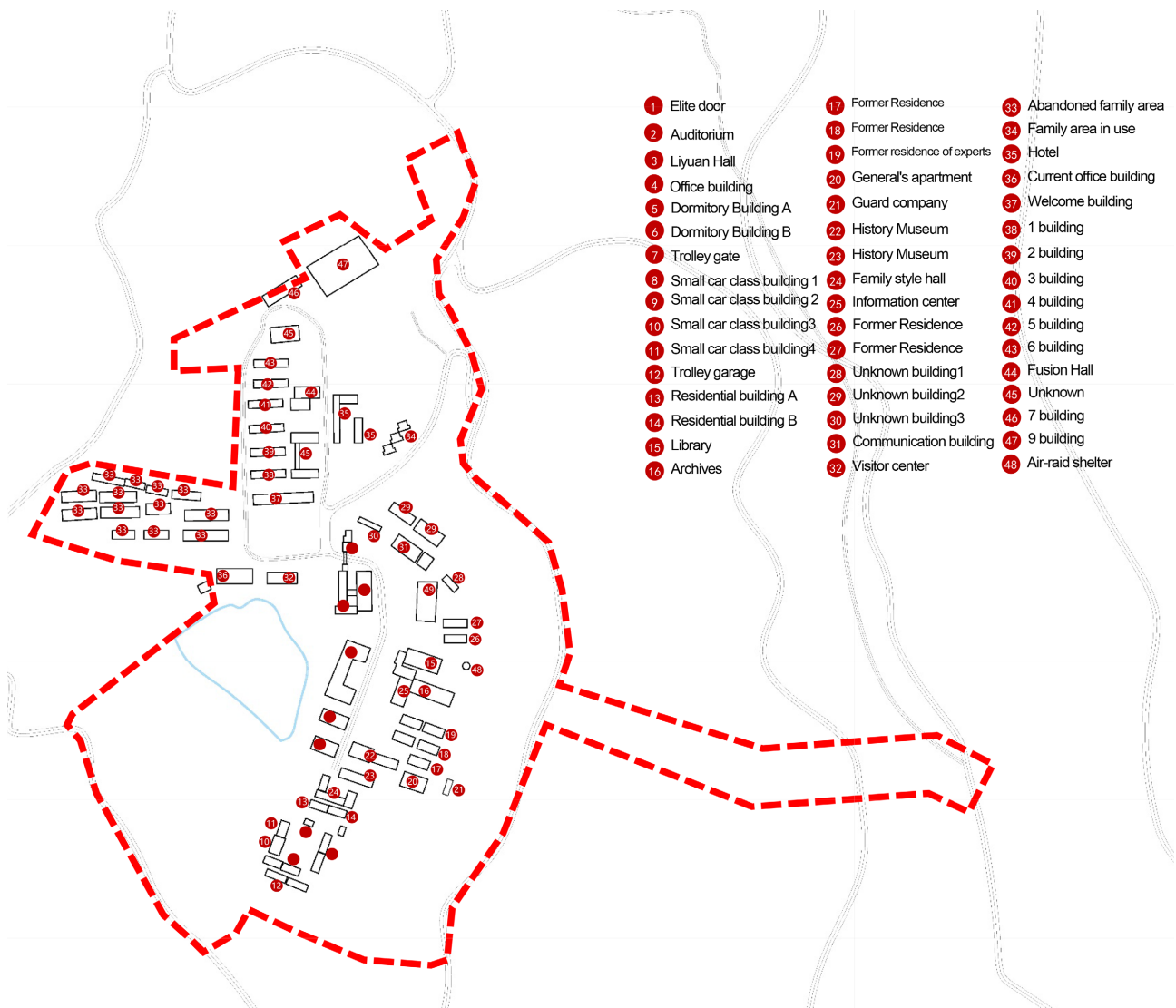


Figure 3. Map of the spatial elements of the industrial heritage of the Two-Bomb City and the three lines of construction (Source: Self-drawn by the author).

distribution status of buildings with different attributes can be derived, and this function can realize the graded and classified protection of the third-line industrial heritage buildings. The key protection is implemented for the surviving buildings with high aesthetic value, bearing historical events, outstanding architectural appearance and well-preserved buildings, while the general protection is implemented for the surviving buildings with certain historical significance, artistic value and basically well-preserved appearance.

4.2. Decision Support Technology for “Multi-Planning”

The concept of “one map” is not only the construction of a database collection of various data, but also the construction of a comprehensive platform of informationization and a wisdom management system, which is the bearer of data integration and transmission, and the platform for the maintenance and management of planning data and the consolidation and display of planning results. The concept of “one map” is not only the construction of a collection of various data databases, but also the construction of a comprehensive platform and a wisdom management system, which is the bearer of data integration and transmission, and a platform for maintenance and management of planning data and consolidation and display of planning results. Relying on the existing GIS database, an information management platform for the industrial heritage resources of the third line can be established, which can be linked with other related planning information mechanisms to “land” management and use control of relevant spatial elements and strengthen the overall protection of the industrial heritage resources of the third line and the surrounding environment [6].

4.3. A Conservation Model that Promotes Public Participation

The establishment of the “Third Line Industrial Heritage Online Database” will enable the government, experts and the public to know more about the Third Line industrial heritage, which will greatly enhance the public participation in the protection of the Third Line industrial heritage. In the future, the information sharing service platform of China’s third-line industrial heritage can also be built, with the openness and transparency of information search and the timeliness of information uploading for all people, so that everyone can participate in the protection of the third-line industrial heritage.

5. Conclusion

The historical and cultural “one map” discussed in this paper is only the basic framework and supporting work specifications for the preservation of the bottom line. With the refinement of urban development management, the database content will be more detailed and diversified, including detailed regulations on building form, building color, internal space transformation, etc.; data records of the whole life cycle from building construction to demolition; technical and administrative mechanisms for integrating and connecting with other plans in the

context of territorial spatial planning and “multi-planning”. In the future, it needs to be improved and enhanced according to the new situation and new problems, so as to better and more efficiently assist the protection of the industrial heritage of the third line and the management and approval of planning.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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