

## ENVIRONMENTAL PRESERVATION IN LARGE SCALE DEVELOPMENT PROJECTS

*Hiroshi Horikoshi*<sup>1</sup>   *Toshiyuki Ishikura*<sup>2</sup>  
*Noboru Takayama*<sup>3</sup>   *Yasutaka Iwasaki*<sup>4</sup>

### Abstract

In large scale development projects, a certain amount of forest area has to be preserved due to the land development regulation. However, in many cases, the relict forests are preserved without proper management. The development project presented in this paper adopted the so called "Nature Recovering Construction Method" for the first time as a private enterprise. The management of relict forests and the creation of a biotope were carried out to preserve and restore the natural environment as well as to establish an educational model field.

**KEYWORDS:** *biotope, relict forest, management, preservation, restoration*

### 1. Introduction

In large scale development projects, the forest area to be preserved is specified by the land development regulation, leaving a certain minimum amount of forest area inside of the project area. However, in spite of its condition, the relict forest is usually left without being managed and monotonous planting of seedlings is done in many cases.

On the other hand, there is a consciousness arising towards the protection of the natural environment in society today. The interest of people towards preservation is not only of a primal nature, but also of the nature that surrounds them in their everyday life. Also, there is a tendency that schools including elementary and junior high schools implement curriculums concerning environmental issues.

Based on the Sanden corporate policy of "coexistence of environment and industry", the development project reported in this paper adopted the so called "Nature Recovering Construction Method" for the first time as a private enterprise. The "Nature Recovering Construction Method" was firstly conducted in Yahagi River (Aichi Prefecture) in 1992. Environmental preservation methods such as the thinning of relict forest, the transplanting of scarce plant species, and the creation of biotope using reservoirs were employed based on an environmental assessment statement in the project.

---

1 Senior Adviser, Forest Department, Administration& Personnel Division, Sanden Corporation

2 General Manager, Administration Department, Administration& Personnel Division, Sanden Corporation

3 Professional Engineer, General Manager, Environmental Planning Group, Environmental Engineering Division, Kajima Corporation, Tokyo, JAPAN

4 First Class Architect, Manager, Project Planning Department, Real Estate Development Division, Kajima Corporation, Tokyo, JAPAN

## 2. Outline of the Construction Site and Environmental Preservation Project

### 2.1 Project Site

The construction site is located on the southern foot of Mt. Akagi, and consists of gently sloped plateaus and dissected valleys formed in volcanic ashes. The elevation ranges from 350m to 500m. Its potential natural vegetation is thought to be a community of Broad-leaved Evergreen Oak (*Quercetum myrsinaefolia*), but it has been replaced by substitutional vegetation, and the land was mostly covered by abandoned farmlands, afforestations, and secondary forests. For this reason, the component species of the vegetation was simple throughout the area before construction.

The plateau located inside the construction site was mostly occupied by farmlands, pastures, and mulberry plantations, or the Barnyard Millet (*Echinochloa crus-galli*) community and the Lamb's quarter (*Chenopodium album*) community formed after the land was abandoned. The secondary forest formed by coppie forest trees such as the Oak (*Quercus serrata*) and the Japanese Red Pine (*Pinus densiflora*) covered the area surrounding the plateau and its slope. Bamboos (*Pleioblastus chino*) thickly covered the forest floor and the Japanese Cedar (*Cryptomeria japonica*) plantation covered the slopes and bottom of valleys. Therefore, the vegetation was far from being natural. However, potential natural vegetation such as the Common reed (*Phragmites australis*) community, the Sedge (*Carex dispalata*) community, and the Japanese Alder-Japanese Willow (*Alnus japonica-Salix gilgiana*) community on the north bank of the reservoir (Obayashinuma) near the construction site were found in some areas.



 :project area

Photo 1 Aerial photograph taken after completion of the project



The fundamental concepts of the project were the preservation, restoration, and the creation of the natural environment as well as the introduction of an educational model field for the young generation. The abandoned cultivation land was utilized as a factory lot, and the streams that ran on the east and west of the construction site was preserved. The relict forest was tended so as to create a space where people can come and feel the nature as it is. The outline of the project site is summarized in Table 1.

Table 1 Outline of the project site

Project Site	Nakanosawa Kasukawa Village Seta county Gunma, Japan
Land Area	641,000m <sup>2</sup>
Construction Area	220,000m <sup>2</sup>
Roads, Parking Area	92,000 m <sup>2</sup>
Forest, Reservoir Area	329,000 m <sup>2</sup>
Total Soil Volume	1,475,200m <sup>3</sup>
Construction Period	2000.3~2002.3

## 2.2 Environmental Preservation Project

### (1) Creation of Biotope

The reservoir located inside the construction site was an important surrounding environment for plants and animals since the Obayashinuma located in the southern part of the area was the only available water surface. To provide habitats for many plant and animal species, and to establish a rich ecosystem, the reservoir was designed as a biotope (Photo 2). Seedling trees which were the component species of the potential natural vegetation were planted on the slopes in the area, and the forest floor was layered with soil from the site to restore the original herb vegetation. The waterline of the reservoir was shaped in an irregular manner to create living spaces for hydrophytes, and the depth of the water was also changed in a similar way (Figures 1 and 2). Rocks from the construction site were reused to create a porous waterbed at the bottom of the slope (Photo 3). A similar bed was also made by the side of the concrete dam by piling up large size rocks to cherish habitats for plants and animals (Photo 4). The “Nature Recovering Construction Method” was employed on the sluices (Photos 5, 6 and 7).



Photo 2 Biotope type reservoir

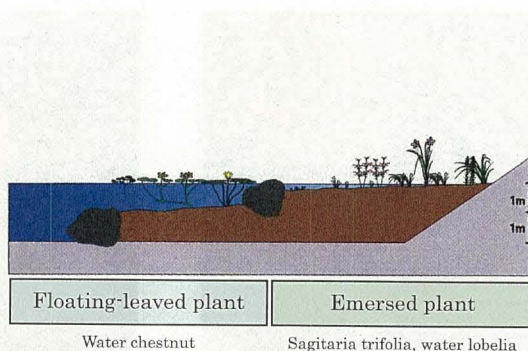


Figure 1 Cross section of the reservoir



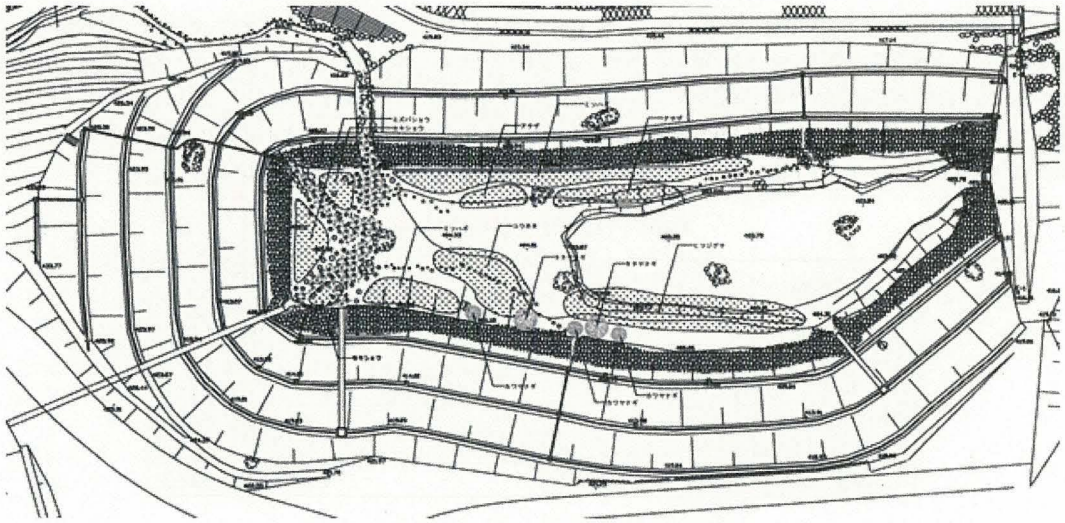


Figure 2 Land plan of the reservoir



Photo 3 Porus waterbed at the bottom of the slope



Photo 4 Rocks layered on the side of the concrete dam

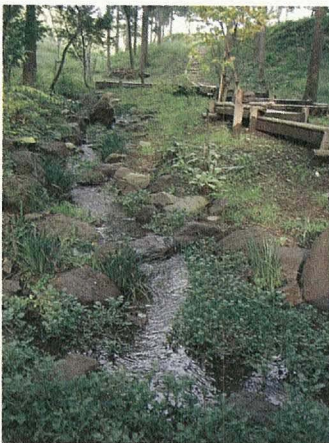


Photo 5 The firefly sluice



Photo 6 Bypass sluice

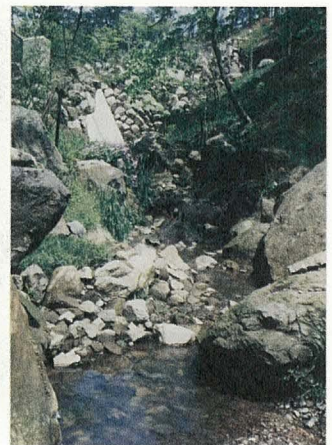


Photo 7 Drainage sluice



## **(2)Protection of the Relict Forest**

According to our previous environmental assessment, two problems were noted on the condition of the relict forest which covers about 20% of the construction site. One was the lack of sunlight inside the Japanese cedar plantation due to the overpopulation of thin trees. The other was the forest floor which was overpopulated by bamboos blocking other forest floor vegetation. Improvement of these conditions was thought essential to recover the bio-diversity of the ecosystem and at the same time protect the remaining natural environment. Therefore, weeding and thinning was done in these forests (Photo 8) to improve the light condition of the forest floor, creating living spaces for scarce species. Another idea employed was to utilize such forest as an educational field that is accessible to everyone. Wood walks were made to create a good hiking course and the posters and signs were set up for the visitors on the various observation points (Photos 9 and 10).



Photo 8 Thinning and Weeding in the Relict Forest (From the left:Before thinning and weeding; Measurement of light condition ; After thinning and weeding)



Photo 9 Wood walks made inside the forest



Photo 10 The posters along the hiking course

### (3)Recycle of Waste

There were about 20,000 stones that unearthed during the land development. Usually, these stones would be carried out, or buried inside the site. Instead, they were used to vitalize a natural habitat for plants and animals by making porous beds in various points.

The area of trees cut down in this project was about 50 acres, the trees mostly consists of cedar and pine. The number of cut trees was about 23,000. Every tree was recycled as construction materials. The 42% of the trees were used as plain wood boards for walks and platforms; the rest (58%) was used as wood chips for covering ground and pavement.

## 3. Results

### 3.1 Vegetation Changes in the Relict Forest

The relict forest is located in the northeast and southeast of the construction site. Most of the area is a Japanese Cedar plantation area, and the rest are the secondary forests of pine and oak. Although the physiognomy and plant distribution has not changed drastically from the vegetation map observed before the construction, the thinning and weeding has eliminated or stunted the bamboos which was the dominant species covering the forest floor. This has improved the light condition, and the clusters of the Hitorisizuka (*Chloranthus japonicus*) and the Anemone (*Anemone flaccida*) has been observed inside the cedar plantation located in the southeast. On the other hand, although the wood chips mulching in the northeast cedar plantation has effectively reduced the growth of bamboos, growth of other forest floor species such as ferns, herbs, as well as shrubs has reduced also.

The observed number of plants before and after the construction are respectively shown in Table-2. The table shows that the number of species has decreased after the construction.

Table 2 Number of higher plants observed

	Before construction	After construction
Family	91	87
Genus	252	220
Species	366	315

### 3.2 Preservation of Scarce Species

Plant species such as the Japanese Spring-orchid (*Cymbidium goeringii*) (prefecture Red Data Book(RDB)-Near Threatened(NT)) observed in the previous survey was recognized in the post-construction survey as well. The Primrose (*Primula sieboldii*) (Nation RDB-Endangered(EN), Prefecture RDB-Critically endangered(CR)), and the Saihairan (*Cremastra appendiculata* (prefecture RDB-NT) were newly found after the construction. The transplanted plant species such as the Calnthe orchid (*Calanthe discolor*), the Common Day Lily (*Hemerocallis fulva*), the Marsh Marigold (*Caltha palustris*), the Skullcap (*Scutellaria pekinensis*), the Okumomijihaguma (*Ainsliaea acerifolia*), the Hostas (*Hosta albo-marginata*, *Hosta montana*), the Toad Lily (*Tricyrtis affinis*), were preserved even after the construction. Since the transplantation of the Golden Orchid (*Cephalanthea falcata*) is originally thought

to be difficult, it was left alone in its habitat. Unfortunately, there is a possibility of its habitat being taken over by overpopulating bamboos.

The rare animal species found inside the site were the Grey Bunting (*Emberiza variabilis*) (prefecture RDB-Least concerned(LC)), the Dobsonfly (*Protohermes grandis*), and the Fresh Water Club (*Geothelphusa dehaani*). The Grey Buntings were not found after the construction, but the Dobsonflies and the Fresh Water Crabs were observed from time to time through out the region. Also, the King Fisher (*Alcedo atthis*) which was seen outside of the construction area was observed inside the site, and the generation change of the Japanese Rice Fish (*Oryzias latipes*) was clearly seen inside the biotope. As a whole, the number of rare animals has increased inside the site.

### 3.3 The Effect of Biotope

The 31 families, 71 genus, and 90 species of higher plants were found inside the biotope area. The existing vegetation are the Round Leaved Dock (*Rumex obtusifolius*), and the Dropwort (*Oenanthe stolonifera*) which are commonly found weeds on roadsides, and the White Clovers (*Trifolium repens*), the Chinese Lespedeza (*Lespedeza juncea*), and the Festucas (*Festuca elatior* Linn.) which are species used to for the greening of slopes. In some areas emergents and floaters like the Pygmy Water Lily (*Nymphaea tetragona Georgi*), the Anceps (*Lythrum anceps*), the White Skunk Cabbage (*Lysichitum camtschaticense*) were planted, and hydrophytic plants such as the Dropwort, the Postrate False Pimpernel (*Lindernia procumbens*), the Sawahiyodori (*Eupatorium lindleyanum*), the Common Reed, and the Broad-leaf Cumbungi (*Typha orientalis*) can also be seen. With proper maintenance, the restoration of the natural vegetation will be made possible.

The animal species found before construction were limited to few species such as ducks, aquatic birds, and dragonflies. However, birds such as the Spot-billed Duck (*Anas poecilorhyncha*), and the King Fisher have been seen after the biotope construction. In April of 2004, the Green Sand Piper (*Tringa ochropus*) was seen in the wetland of the biotope, and it was thought that the creation of the biotope has produced habitats for plant and animal species living in the area, and has increased the diversity of the ecosystem.

## 4. Discussion

With the help of neighboring elementary school teachers, a good outdoor educational program was established for elementary and middle school students. The present biotope could also become useful for many people including adults to enjoy the well-conditioned nature. To maintain the good condition, a rational management method is absolutely required. The following would be recommended.

- 1) In the relict forest, the preservation of summer-green shrubs, and the selective thinning and weeding of evergreen shrubs must be operated, such as the Gold Dust Japanese Aucuba (*Aucuba japonica*) and other plant species that would suppress other species from growing.
- 2) The plant waste from the greened slopes and forest floor should be recycled as compost or other forms.
- 3) The objective of the biotope around the reservoir is the development of a diversified wetland environment. When introducing new species, the seedling should be selected from the vicinity, and

sowed. Planting of unknown species should strictly be prohibited.

- 4) The maintenance by the selective weeding should be carried out when weeds, slope greening species, and naturalized species are spotted frequently and plagiosere has been confirmed in the biotope.

There are many cases that abandoned agricultural land has the secondary forests and the reservoirs in it. In these cases, we can add a new value to it by preserving and restoring the natural environment. As a result, a quite good opportunity will be provided for many people to enjoy the natural beauty as well as the natural secret.

## 5. Conclusion

The number of habitats for plant and animal species increased by creating the biotope and improving the condition of the relict forests in the project. The methods and the procedures introduced in this paper would be and extremely good example applicable enough to other similar development projects in Japan.

## 6. Acknowledgement

We would like to thank Shubun Fukutome of Nishinohon Institute of Technology who has introduced the so called "Nature Recovering Construction Method" to Japan and was the ground planner of the project presented in this paper. We would also like to thank Yuji Yoshinouchi of Nishinohon Institute of Technology for professional advises in the project.

## References

- Nature Recovering Construction Method Research Committee (1994): The Philosophy and Technology of the Nature Recovering Construction Method, Supervised by Fukutome S. (in Japanese)
- Fukutome (1994): The Idea and Concept of the Nature Recovering Construction Method. *In* Nature Recovering Construction Special Edition 3 "Paddy Field Biotope", Shinzansha Sci-Tech Publisher Co. Ltd. (in Japanese)
- Ministry of Land, Infrastructure and Transport Kyusyu Regional Development Bureau River Department (2003): Application of Traditional Spur Dyke to the Nature Recovering Construction Method. (in Japanese)
- Goeldi, C., Fukutome S. (1994): Study of the River Nature Recovering Construction Method, Shinzansha Publisher Co. Ltd. (in Japanese)