

ROYAL
BOTANIC
GARDEN
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Institutional Capacity Building and Training,
Royal Botanic Garden Serbithang, Bhutan.
August 2003 – April 2006

Annual Report No. 2
1 April 2004 – 31 March 2005



Darwin Initiative for the Survival of Species Annual Report

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Front cover photograph: Bhutanese school children attend an education workshop at RBGS

1. Darwin Project Information

Project Ref. Number	162 / 12 / 024
Project Title	Institutional Capacity Building and Training, Royal Botanic Garden, Serbithang, Bhutan
Country(ies)	Bhutan
UK Contractor	Royal Botanic Garden Edinburgh
Partner Organisation(s)	Royal Botanic Garden Serbithang
Darwin Grant Value	£124,635
Start/End dates	1 August 2003 – 31 March 2006
Reporting period	1 April 2004 to 31 March 2005 Annual Report number 2
Project website	N/A
Author(s), date	Dr David Rae, March 2005

2. Project Background

The project is located at the Royal Botanic Garden Serbithang (RBGS) which is situated about 10km west of Thimpu, the capital of Bhutan. The Royal Government of Bhutan established their National Biodiversity Centre (NBC) in 2000 in response to the Convention on Biological Diversity and the need to conserve their biodiversity. The NBC includes RBGS, the National Herbarium and the National Genebank. While the Herbarium and Genebank have been established with relative ease, the botanic garden struggled through a lack of trained staff and resources, both in horticulture and education. The Darwin project arose from a direct request from Lympo Dr Kinzang Dorji, Bhutan's Minister of Agriculture, who visited the Royal Botanic Garden Edinburgh (RBGE) in January 2002 to celebrate the completion of the *Flora of Bhutan* project.

The primary purpose of the project is to develop RBGS and raise standards of knowledge and capacity so that the Garden and its staff have the ability to engage fully with the demands of the CBD. When the project started the Garden was not functioning as a modern botanic garden should and therefore had no scope to contribute to the CBD. Through the project it is hoped that standards of cultivation, maintenance, curation, propagation, record keeping, interpretation and education can be improved greatly. Once these basic requirements for a botanic garden have been achieved then it is hoped that the garden will have the opportunity to reach up and engage with conservation, biodiversity and sustainability issues and, in so-doing, fulfil its responsibilities towards the CBD.



Fig 1. Ross Irvine teaches propagation techniques during a workshop session

3. Project Purpose and Outputs

The ultimate purpose of the project is to raise standards in RBGS so that it can realise its full potential and can eventually contribute to sustainable development and the objectives of the CBD, particularly to environmental education, conservation and research. Before it can do that a number of fundamental activities need to take place that can best be described as institutional capacity building and training. They are as follows:

1. To enable staff to propagate and cultivate plants. This will be achieved by helping to develop a nursery, arranging staff exchanges and holding propagation workshops.
2. To give the staff an understanding of collection curation through plant records, collections policies and collections management.
3. To help develop the interpretative potential of the Garden, including plant labelling, a map/leaflet and interpretative information.
4. To equip staff with the ability to use the Garden and its resources for educational activities, for school teachers, school children, students and the public in general, including tourists.

The logical framework showing activities and outcomes is shown in Appendix I, nothing in it has changed from the original version and everything is on target. Achievements against it are reported in the next section describing progress during the year. The slight delay to the construction of the nursery that was reported last year has been overcome and so everything that should have been achieved during the first two years has now been achieved. It is pleasing to report that additional (non Darwin) funds have been found during the year to send an extra member of RBGE staff to Bhutan and an extra member of RBGS staff to Edinburgh.

4. Progress

The general plan for the whole project has been to provide very practical, hands-on help to RBGS in the areas of horticultural and educational training and capacity building. Ultimately, the garden should be able to contribute to biodiversity research, conservation, education and sustainability but, before that could ever happen, it needed to be able to function as a modern botanic garden. Practical, hand-on help and training was required in areas such as propagation and nursery work, plant records, landscape construction and maintenance, interpretation and education, tree planting and botanic garden management. This Darwin Initiative project has been providing just this sort of help through staff exchanges, training workshops, the development of various plans, education training, demonstrations and practical, shoulder to shoulder garden work. To achieve this the project has been broken down into a series of individual, but linked events and activities.

All the work that should have taken place during the year has taken place and is summarised below. Some timings changed slightly from the timetable given in last year's report but these were only to take account of some difficulties in travel schedules and of other staff commitments. Also, Sangay Dema was unable to come to Edinburgh to take part in the training programme as described in the timetable as she was pregnant but her place was taken by another, newly appointed, member of staff - Sonam Tobgay (who has been appointed to the new post of Supervisor). Apart from those two minor details everything was accomplished as agreed.

In June David Rae visited the Garden to check on progress since the last visit and finalise arrangements for the coming year. During that time he was able to spend a lot of time with Dr Ugyen Tshewang, Director of NBC discussing the timings and outputs of the project and also the long term plans for the Garden. He also spent time with Sangay Dema, Garden Curator, discussing botanic garden management issues. During this time he also wrote a collections policy (shown in Appendix II) jointly with Sangay and did a little practical work.

In May Peter Baxter, Curator of Benmore Botanic Garden (one of RBGE's regional gardens) and Clare Morter, a member of horticultural staff from Edinburgh visited RBGS for a three and four week period (respectively) to lead practical workshops and undertake practical project work. Their report and recommendations are shown in Appendix III. This visit was highly successful and a lot was achieved. Much of the work focussed on tree establishment and maintenance but Peter and Clare also spent a lot of time with Sangay Dema discussing and giving advice on a whole range of issues and areas of concern. During the last week in particular, when Peter had returned to Scotland Clare was able to spend a considerable amount of time, especially with two of the women staff, developing their knowledge and interest and I think this was particularly valuable. Interestingly, this visit led on to a request for Peter Baxter to visit again (funded by the Bhutanese) with a landscape architect from Edinburgh to give advice and outline guidance on a proposed national park.

In July Peter Brownless, a Supervisor at RBGE responsible for the nursery, and Ross Irvine, a senior horticulturist, visited RBGS to help organise and establish the nursery that had been delayed from the previous year. Ross' visit was paid by RBGE as a contribution to the project and to help his own training and development potential. Peter and Ross led numerous propagation workshops and helped oversee nursery

developments. They also gave a lot of advice and did a lot of general maintenance work. It was an excellent visit and a fuller account appears in Appendix IV.

Three staff from Edinburgh's Public Programmes Division visited in July. Their education report is shown in Appendix V and interpretation Master Plan in Appendix VI. The staff involved were Dr Ian Darwin Edwards, Divisional Director, Cath Evans, our primary school teacher and Stephanie Walker who had been working at RBGE on contract dealing with education and interpretation. This was a highly successful visit and a superb amount was achieved. Outputs included teacher training workshops, demonstrations of education classes with school pupils, an education strategy, an interpretation strategy and a start with designs for interpretational material. There were also lengthy discussion with Sangay and others about practical issues of running education classes in the botanic garden. Interpretation design has continued in Edinburgh. Information for 12 interpretation panels has been collated and designs developed. These are currently with staff at RBGS for comment. The panels will be produced and positioned in Year 3.

Jeanette Latta and Rob Cubey visited Bhutan in November to develop the plant records system in the Garden. Their detailed report is shown in Appendix VII. Plant records are fundamental in botanic gardens as they link information to individual plants. In a museum a lot would be known about each object within a collection - information such as where a piece came from, how and when it was made and why it was important or representative of a particular time or style. In botanic gardens it is the plants that are the objects in the collection and it is equally important that information is attached to them. In this case data such as date and location of collection, altitude, habitat and associated plants would typically be held. The only practical way to keep this information is through purpose designed databases and RBGS has such a database called BG Recorder which is freely supplied by the major botanic garden networking organisation – Botanic Gardens Conservation International (BGCI). It is, however, very difficult to start up a system such as this 'from cold'. Most botanic gardens have developed methodologies for applying numbering systems (accession numbers), locating plants (gridding and mapping), creating inventories of areas, stocktaking and much more. It is now almost impossible to manage a detailed plant collection without a plant records systems but help is needed to get 'up and running'. This visit proved to be highly successful, a lot was achieved and the staff at RBGS were very grateful. During this visit information was collated to start producing plant labels for the plants. Originally it had been suggested that we might use local craftsmen to hand paint these labels in traditional style. However, at the request of staff at RBGS we decided to use traditional engraved white on black botanic garden labels. The reason was two-fold; firstly it would make RBGS 'look like a botanic garden' and second they are more standard and quick to produce. Virtually all the plants in the garden were labelled with temporary labels and the engrave labels followed in batches of 80-100.



Fig 2. Rob Cubey leads a plant records workshop

In January three staff from RBGS arrived in Edinburgh for horticultural training. Sonam Tobgay and Tshring Wangmo were funded by the Darwin Initiative project and stayed for 4 weeks and Wangmo Moitra was funded by a bursary from the Royal Horticultural Society and stayed for 8 weeks. During their stay at Edinburgh it was a pleasure to see that they made the very best use of their time and it was also very pleasing to note that staff at Edinburgh made an enormous effort to look after them and make sure that they had a valuable time from both a training perspective and also culturally and socially. During their time they gained a lot of very valuable practical experience in all departments of the Horticulture Division and also in the Public Programmes Division where they learnt about education and interpretation. They were also given the opportunity to travel to and work in our regional gardens. Again, this was a most worthwhile and valuable visit.



Fig 3. A practical turfing session at RBGE

The timetable for next year is as follows:

April 2005	Neil McCheyne Barbara Gordon	Horticultural training and workshops, landscape construction and maintenance
August 2005	2 staff from RBGS	RBGS staff to visit RBGE for horticultural training
Sept 2005	Ian Darwin Edwards Karl Stevens	Interpretation implementation & design of map/leaflet
Oct 2005	David Rae	Annual management visit - assess work to date and finalise any outstanding work
Feb 2006	Sangay Dema	Final visit, finish outstanding work and discuss botanic garden management, conservation and sustainability issues

5. Actions taken in response to previous reviews (if applicable)

The Annual Report Review written on the first year report of the project was generally very encouraging and supportive. All comments seemed fair and were helpful. They have been discussed with Sangay Dema and Dr Uygen Tshewang and we have tried to take them on board for Year 2 of the project. We are not sure that we have perfect answers or solutions to all the comments, but we have certainly tried to incorporate them where possible.

- i) *The close partnership between RBGE and RBGS does not come out strongly in the report and there was no evidence of the joint project manager contributing to the report*

Unfortunately Sangay Dema was on maternity leave for the second half of Year 2 and has not, therefore, been able to contribute to the report again. However, I have tried to convey the closeness of the collaboration between the Gardens and between staff throughout the report. I can genuinely say that there is a very close collaboration between the staff in both Gardens. They all get on with each other very well and this has had an excellent knock-on effect into the training and workshops where all staff have contributed very effectively and have worked well beyond their allotted time.



Fig 4. Bhutanese visitors to Edinburgh are introduced to Scottish country dancing

ii) *The long term viability of RBGS*

It is appreciated that the long term success of RBGS is dependent on strong and effective management systems and financial viability. Taking the second point first, it is true that a government-funded garden is at the mercy of public sector cut-backs in funding but the Government of Bhutan seems to be investing very considerably in the whole of NBGS with the development of the Gene Bank and Herbarium as well as the Garden. A garden supervisor, Sonam Tobgay, has recently been appointed and there are plans to appoint an education officer soon. Investment in terms of landscaping and facilities are continuing to be made into the Garden and so funding, at least for the present, doesn't seem to be a major concern.

Sound and effective management systems are certainly important and we hope that we are making an effective contribution to laying the correct foundations in this respect. Helpful and practical reports have been submitted, along with appropriate training. Likewise, the more senior staff visiting RBGS had had lengthy discussions with the more senior staff at RBGE to discuss management systems. Staff appraisals and evaluation

by the Civil Service is also well developed in Bhutan and this lends considerable support in terms of direction and management.

iii) Importance of a project based exit strategy

In the application and in last year's report I stressed that in some ways there was no need for an exit strategy as RBGE would continue to have a long term interest in Himalayan botany and in Bhutan. However, I can see more clearly now that what is required is an exit strategy from this particular project and thought has been given to this idea. The application was structured in such a way that the project had a definite start and end and RBGS, who were involved in developing the application, know this and are therefore expecting the project to end at the end of this year. Hopefully, enough knowledge and information will have been conveyed to allow the Garden to flourish and develop on its own. Also, we have always made it clear that this project was a means to an end, in other words we wanted to get the Garden at Serbithang 'up and running' as a modern (but still young and new) botanic garden first, so that it could then start to develop the ideas and commitments of the CBD. We very much hope that the help we have been able to give will enable RBGS to make this step in the future and, indeed, I hope to apply for post project funding to help with the start of this transition. However, until the 'basics' are in place it would be very hard for them to make this leap forward.

I am not sure that I have answered this very satisfactorily except to say that I hope we will have prepared RBGS sufficiently well by the time the project ends to allow them to continue to progress on their own without too much help (though we will always be happy to provide advice). I would be very happy to receive advice on other exit strategies from other Darwin projects.



Fig 5. Teacher training workshop. Looking at how to use the Garden for Biology, and other, classes.

6. Partnerships

It is very pleasing to note again that the partnership has worked very well and that there have been no difficulties. All travel and domestic arrangements in both countries have worked very well, thanks in large part to Rachel O'Connor, David Rae's PA who has made all the travel arrangements, booked all the accommodation, obtained all the visas and made sure everybody had the right amount of money. Staff at RBGS have been unfailingly kind and helpful and have arranged everything that they should have. They have also looked after visiting staff very well socially, including evenings and weekends. Likewise staff at Edinburgh have gone out of their way to be kind and helpful to visiting staff from Bhutan. They have tailor made training programmes, workshops and work experience so that staff from RBGS extracted maximum benefit from their visits, in both countries.

The botanical park master plan that RBGE was asked to undertake as a direct result of the Darwin project progressed well. Peter Baxter visited Bhutan later in the year with a landscape architect to undertake the work. The master plan was delivered later in the year and we await an opportunity to become more involved at a later date. It was very pleasing to note that the landscape architect's firm took a great interest in this project and devoted many, many more hours to the job than was warranted by the income. The output therefore greatly exceeded expectations and the computer modelling, for instance, was of the highest quality. Note was also made last year of an impending EU funded project concerning medicinal plants. RBGE was invited to tender for this project, again largely as a result of the Darwin initiative project. The application was successful but, in the end, RBGE was a fairly minor player in this ECTF co-ordinated project as we could not devote any staff on an almost full time basis to the project. The project will almost certainly be using the facilities of RBGS for training workshops to show farmers how to grow and propagate medicinal plants and so there will be a mutually beneficial relationship between the botanic garden and the EU medicinal plants project.

7. Impact and Sustainability

The project is well understood within both the National Biodiversity Centre and government circles. David Rae again visited a number of Ministers during his visit and he also had a meeting with the Chancellor of the University of Bhutan (who had visited Edinburgh earlier in the year). At all these visits the aims and outcomes of the project were explained in detail. The visit by the education and interpretation group was very successful and involved several teachers and others from outside the botanic garden world and during the various workshops the aims of the project were described. It is from such meetings that the purpose of the Darwin Initiative and this project in particular can be explained and then cascaded on to others.

Newspaper and TV coverage of the project had been a planned output from David Rae's visit but, unfortunately, Bhutan's Queen Mother died while he was there and the country went into a period of mourning with the effect that very little else was covered during that period. However, the education and interpretation visit received good TV coverage.

There is no doubt that the project is starting to have an impact. The quality of the garden is improving, plants are surviving, staff are more confident in what they are doing and visitor numbers are increasing. It was made very clear in the application that these factors alone would not contribute to the aims of the CBD but, without them happening first, RBGS could never reach up and contribute to the CBD. The primary focus for this very new garden must be to get established, to look good, to be functioning as a botanic

garden with labels, information and education. Once these fundamentals are in place, then they can concentrate on the CBD. The purpose of this project was a means to an end, to help the garden through the start up phase and it is delightful to witness this starting to happen. The impact, then, both visually, in the underlying structures and in the minds and perception of staff and politicians is beginning to be apparent.

The exit strategy remains the same as last year (and is reproduced below), but includes some additional plans. It is envisaged that collaboration between RBG Edinburgh and RBG Serbithang will continue long after this particular project ceases. The Darwin funded project is part of an ongoing fruitful relationship between RBGE and the Government and people of Bhutan and we intend to continue to work collaboratively. Himalayan botany remains a priority area for Edinburgh and scientists and horticulturists are expected to use Serbithang as a base for future work in the region and to continue to strengthen and develop the relationship between the two institutes for the foreseeable future. In this respect therefore, there is no exit strategy, this project is just one new development in a continuing climate of cooperation and collaboration. Indeed, two new projects (as described above) have arisen during the past year. However, as described in Section 5iii more emphasis is now being placed on a project exit strategy by ensuring that RBGS has the knowledge and resources to flourish after the project has come to an end.

8. Post-Project Follow up Activities

We would like to be invited to apply for post project funding in 2006-07 specifically to develop the CBD, conservation and sustainability aspects of RBGS. It has always been made clear that the purpose of the project was to get the garden 'up and running' so that it could function as a modern botanic garden. Thereafter it should be able to start contributing to the ideals of the CBD. Conversely, without the training and capacity building offered by the Darwin project the Garden would struggle to get itself established as a modern garden and would find it hard to move on to CBD issues. As the part of the NBC which is also the CBD focal point it is highly appropriate for the Garden to be working on CBD issues and we would therefore like to be considered for post project funding specifically to start developing these activities and strategies. Activities would include two visits each way for senior staff, visits to 2 other major botanic gardens, (to see/discuss how they approach this), possibly a small conference in Bhutan with key players and attendance for one or two RBGS staff on RBG Kew's botanic garden management course. There is NBC and governmental commitment in Bhutan to pursuing this idea.



Fig 6. Watering in the Orchidarium

9. Outputs, Outcomes and Dissemination

The second year of the project has gone very well and has built upon the work and relations developed in the first year. The outputs agree exactly with the 'Project Implementation Timetable' and the 'Project Outputs Schedule'. Everything was achieved that should have been achieved. The delay (due to contractual and paperwork issues, ie outwith the jurisdiction of the Darwin project) to the nursery construction that was reported last year has been rectified and everything is now complete and on budget.

Outputs in terms of activities, as opposed to exchange visits and projects, have included training and workshops in the following areas: horticultural practice, propagation & nursery work, botanic garden maintenance, plant records, education and interpretation. Other outputs have included reports such as the collections policy, interpretation policy, education policy, design of interpretation, plant identification, plant labels and hands-on practical working.

Dissemination of information to target audiences has included: horticultural training and workshops to at least 6 staff in Bhutan, intensive horticultural training to 3 Bhutanese staff in Edinburgh (2 paid by Darwin, the other from an RHS grant), education training to at least 15 teachers and others in Bhutan, interpretation planning to 2 staff in Bhutan and plant records training to 3 staff in Bhutan.

Table 1. Project Outputs (According to Standard Output Measures)

Code No.	Quantity	Description
6A	6 staff	6 staff at RBG Serbithang received horticultural training for 4 weeks (total 24 weeks)
6A	4 staff from RBGS At least 12 other staff (eg teachers)	4 staff at RBG Serbithang received education and interpretation training for 3 weeks (total 12 weeks). Parts of this training also given to at least 12 staff (eg teachers) from outside the Garden (could therefore take the 'Quantity' figure up to 24 weeks in total)
6A	3 staff	3 staff from RBG Serbithang receive 2 weeks of plant

6A	3 staff	records training (total 4 weeks) 2 staff from RBG Serbithang receive 4 weeks, and one member of staff receives 8 weeks horticulture and education training at RGB Edinburgh (total 16 weeks)
6B	52 weeks	Total number of training weeks from above
8	26 weeks	10 staff from RBGE spend project time in Bhutan
12B	1 database enhanced	BG Recorder greatly enhanced at RBGS
18A	1 national TV programme	Education programme features on BBC (Bhutan Broadcasting Corporation)

10. Project Expenditure

Project expenditure has been very close to budget as shown in table 3, below.

Table 2: Project expenditure during the reporting period (Defra Financial Year 01 April to 31 March)

Item	Budget (please indicate which document you refer to if other than your project schedule)	Expenditure	Balance
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*T&S £410.45 overspend was offset against minor underspending in Capital items, Others and Postage with Darwin Initiative agreement.

Please note also that the T&S budget above was Year 1 T&S and Year 2 T&S added together. RBGE agreed not to claim Year 1 T&S until Year 2 of the project at the request of the Darwin Initiative.

11. Monitoring, Evaluation and Lessons

Progress has been monitored on a day-to-day basis by Sangay Dema, Curator of RBG Serbithang (until she departed on maternity leave) who contacted David Rae at Edinburgh by email if issues needed to be discussed. However, as the project has progressed and as everybody started to know what to do and what was expected this contact was much less than in Year 1. David Rae also got important feedback on project work from RBGE staff as they returned from visits to Bhutan and from their reports. De-briefings are always held with returning staff and they are also encouraged to write their reports while they are in Bhutan and therefore while information is still fresh in their minds. David Rae is also in month to month contact with Dr Ugyen Tshewang, Director of NBC, to discuss issues. RBGE staff are also briefed in detail before going to Bhutan (not

only by David Rae but also by others who have been) to ensure they know what was expected from them and how their part of the project fitted into the whole scheme.

Evaluation is generally qualitative and set within the parameters of the Logical Framework. Each element of the project is discussed with Sangay Dema and Dr Ugyen Tshewang at the start of the year to (and at the start of the whole project, in fact) to ensure that it is appropriate, that it is wanted and that it will be of a level that is suitable for staff. Staff undertaking training or workshops are consulted throughout to ensure they are happy and are understanding. Also, with a very practical subject like horticulture it is very obvious if somebody doesn't understand as they simply can't do the work. In these cases monitoring and evaluation is undertaken by observation and if staff are having trouble understanding we simply go through the work again and again until they do understand.



Fig 7. A member of RBGS staff passes on the knowledge of how to make seed packets to Bhutanese school teachers (having first learnt how to do this at an education workshop)

APPENDIX I. Report of progress and achievements against Logical Framework for
Financial Year: 2004/2005

Project summary	Measurable Indicators	Progress and Achievements April 2004-Mar 2005	Actions required/planned for next period
<p>Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve</p> <ul style="list-style-type: none"> • The conservation of biological diversity, • The sustainable use of its components, and • The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources 			
<p>Purpose</p> <p>To build the capacity of the staff and facilities at RBGS so that they can use the resource of the living collections for education, conservation and eventually, for research so that the institute can contribute effectively to the aims of the CBD and to sustainable development</p>	<p>Visually improved botanic garden landscape</p>	<p>Maintenance improved, new garden areas created & great improvement to tree growth. Achieved by workshops, training, exchanges and direct help</p>	<p>Maintenance standards will continue to improve through exchanges and training. The landscape will improve through newly landscaped areas and improved plant growth</p>
	<p>Effective curation of the living collection</p>	<p>Propagation w/shops continued, plant records w/shop delivered and collections policy written</p>	<p>The nursery will continue to 'come on line' as plants start coming through the system and end up in the garden</p>
	<p>Effective communication of biodiversity issues in Bhutan to residents and visitors</p>	<p>Education and interpretation training and w/shop delivered. Education and interpretation plans written. Interpretation designs started</p>	<p>The Garden will deliver more education classes/visits and become more effective in this capacity as a result of the training. Interpretation panels to be installed in Yr 3 and map leaflet to be produced</p>
	<p>Correctly identified and labelled plants</p>	<p>Virtually all plants identified and labelled</p>	<p>Most plants are now labelled with temporary labels. 200 now have traditional botanic garden labels and more will be delivered in Yr 3</p>

Outputs			
An Interpretation Master Plan indicating the most effective way of using the Garden to highlight important issues concerning Bhutan's Bio-diversity	A written Master Plan describing how best to implement an interpretation strategy in the Garden	Interpretation Master Plan completed (see Appendix 3)	Consultation on interpretation design to continue and panels to be installed in Yr 3. Map/leaflet also to be produced in Yr 3.
A Plant Records database in place	A minimum of 2 trained staff in data entry and management, the Garden sub-divided into plant record zones and information on the collection entered into the database	2 staff have been trained, garden subdivided and the database populated with plant records	Training was successful but needs to be reinforced. All newly collected plants to be entered into database
A functional nursery established with 2 staff capable of propagating plants from seeds and cuttings	Plants grown from seed or cuttings survive and are grown in the Garden	Despite the delayed start the nursery is now beginning to function	Nursery work and propagation to be consolidated and more plants need to 'come through the system'
Traditionally printed plant labels installed	At least 500 labels painted and installed. Plants correctly identified	Virtually all plants have been labelled with temporary labels and these are slowly being replaced by traditional botanic garden labels (200 to date)	A decision was taken not to try and produce hand-painted labels (too expensive and slow to produce) but to go for 'standard' botanic garden labels. More to be labelled in Yr 3
An attractive, well maintained Garden with a well curated collection of plants (NB it must be noted that a fine garden with high standards cannot be fully created within 3 years)	At least 6 staff given basic horticultural training Number of plants in cultivation	The garden is becoming more visually attractive as maintenance improves, plant numbers increase and grow satisfactorily and new areas are constructed	Maintenance and garden development work to continue through Yr 3 training programme

<p>An education policy established defining ways in which the Garden can be used for biodiversity education</p>	<p>At least 2 staff trained to use the Garden for educational purposes. A written policy describing ways in which the Garden can be used for educational activities</p>	<p>More than 2 staff have been trained and a written policy has been produced (see Appendix 2)</p>	<p>Education programme to be developed and implemented. Final stages of discussion on interpretation to take place in Yr 3 and then interpretation to be implemented. Map/leaflet to be designed and printed.</p>
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APPENDIX II

ROYAL BOTANIC GARDEN SERBITHANG

COLLECTIONS POLICY

JUNE 2004

Introduction and purpose

The Royal Botanic Garden Serbithang (RBGS) was founded in 1999 as an integral part of the National Biodiversity Centre (NBC) which is funded by the Ministry of Agriculture. The primary purposes of RBGS are as follows:

- To cultivate native Bhutanese plants for knowledge and enjoyment
- To inform and educate visitors about the plants of Bhutan and their importance
- To act as a focal point for environmental education
- To co-operate with other Departments in the conservation of Bhutan's plantlife
- To collaborate with the Herbarium and Genebank in the study and documentation of Bhutan's plant biodiversity
- To become a tourist destination and a place where tourists can find out about Bhutan's plantlife
- To be a place of beauty for the enjoyment of all visitors

The purpose of this Collections Policy is to describe the rationale for the plants that are grown in the garden. It is a long term policy and the aim is to make sure that the right plants are in the right place for the various users or stakeholders. Without a Collections Policy a garden can quickly become a confusing assemblage of plants with little underlying philosophy behind why they were collected or where they have been placed. A Collections Policy, however, should be regarded as a guide and it should be flexible enough to allow for changes in institutional policy and new ideas.

Climatic and soil constraints

While the main focus for RBGS's collections are native Bhutanese plants it should be noted that it will be impossible to grow all species found within Bhutan. The garden is situated at 2,500m elevation in the warm, dry and windy Thimpu valley on a site that has thin, eroded soil, low in organic matter. This puts it in the Cool broadleaved forest/Evergreen oak forest/Blue pine forest vegetation zone(s) but many of the species listed in the Flora of Bhutan as characteristic of these zones are not found in or around the site due to the climate and soil constraints. While most botanic gardens would expect to easily grow species from the vegetation zones immediately above and below it, RBGS will always be severely limited by its site. That said, with care, good

husbandry and careful attention to soil amelioration and irrigation it will still be possible to grow a reasonable number of species.

While the garden site has some limitations there are some good points also. These include the close proximity to the herbarium and genebank and relative closeness to Thimpu. The limitations of the site does, however, point to the desirability of creating regional outstation gardens at different elevations in the future.

Users and Stakeholders

The garden is young and still very much in the development phase. Visitor numbers are therefore very low but are starting to increase. Even at this early stage it is worth considering who the stakeholders are and what their motivation for visiting the garden might be. Possible stakeholders might include:

- Primary and secondary school children visiting as a school party- for an education class
- Families visiting for a picnic- day out in an attractive environment
- Tourists- before or after trek to find the names of plants seen
- Tourists- to see/find out about Bhutan's plantlife
- Biology students- to study plant ecology, adaptation or taxonomy
- Tourists and general visitors- interested to learn about medicinal plants and other plant uses
- Painters, artists and photographers- paint or photograph plants
- Conservation departments, agencies or NGOs- keen to set up conservation projects
- University staff or departments- interested in setting up demonstrations or collaborative projects
- Staff from other botanic gardens- interested to visit to look at plants, cultivation & display techniques and discuss management issues
- General visitors- an attractive and interesting place to visit with good facilities (eg shop and restaurant)

From this preliminary list it is easy to see that the garden must cater for a wide range of interests from the casual visitor to Government agencies. This means that the garden must be 'all things to all people'. In other words it must something for everybody, satisfy the requirements of specialists and maintain high levels of cultivation, maintenance and facilities.

Main types of collection

1. Bhutanese plants

The primary purpose of the garden is to grow native Bhutanese plants and it is recommended that at least 80% of the collection is made up of these plants. Note has already been made of the fact that it will be impossible to grow a wide diversity of Bhutanese plants due to site constraints. However, within this limitation every effort should be made to grow as wide a range and as great a number of Bhutanese plants as possible. In addition, there should be multiple, wild origin

accessions from as diverse a geographical range for each species as possible. To include trees, shrubs, herbaceous plants, annuals and climbers.

2. Exotic plants

While the focus must be on Bhutanese plants there is still a place for some exotics. Exotics can be useful for:

- Comparison- to show similarities or differences from Bhutanese species in the same genus
- Adaptation- to demonstrate particular environmental adaptation (perhaps not easily displayed in native species)
- Biodiversity- to demonstrate the vast diversity of shape and form found in the plant kingdom
- Ethnobotanical use- to show a particular plant use (perhaps not easily displayed in a native species)
- Function- to grow a species for a particular use such as bank stabilization if there is not a suitable native species available
- Beauty- to grow a particularly beautiful species simply because it is beautiful and capable of inspiring visitors to marvel at nature

3. Cultivars

Cultivars have much the same uses as above but cultivars of annual plants have a legitimate role in botanic gardens in providing beauty and a spectacle for the public to enjoy. Even though the main focus of botanic gardens should be on documented wild origin plants it is still important to provide some colour for the public to enjoy.

It is therefore reasonable for exotic plants and cultivars to constitute 20% of the collection.

4. Thematic collections

As well as individual plants planted around the garden it is important and interesting to group plants by type or use. Examples will include:

- Ferns
- Bamboos
- Arboretum arranged by altitude
- Medicinal plants
- Other ethnobotanical plants
- Aquatics
- Warm temperate/tropical plants- a small selection based in the glasshouse
- Orchids
- Rock garden (though the cultivation of many true alpines will be difficult)
- Herbaceous plants

Conservation collections

The garden is not yet, perhaps, in a position to contribute effectively to ex situ conservation but this is very much one of the objectives of the garden once it is more fully established. The Global Strategy for Plant Conservation (GSPC) calls for each country to grow 60% of its rare and endangered species in ex situ collections and RBGS is clearly the place where this should happen. The Convention on Biological Diversity (CBD) and numerous other conventions, policies and guidelines call for conservation measures in botanic gardens. In Bhutan's case, however, further work is required to determine a list of endangered species and this should be a priority for the NBC.

Once a list of endangered species has been determined and once RBGS is more firmly established then conservation collections should certainly be cultivated, again within the limitations of the site. Ultimately all ex situ collections should be considered within a wider framework as part of an integrated conservation policy. In the meantime, if conservation collections are considered they should be very well documented, acquired across a wide range of the plant's distribution, with representatives from as many populations as possible and with as many accessions from each population as possible (ie 10 individuals or more from each population). It is possible that such collections could be established in the upper part of the garden.

Labelling

Bad or inadequate labelling leads to frustration from all users and stakeholders. Ideally plants should be labelled from the moment they enter the collection- first with a nursery label and later, once planted within the landscape, with a permanent label. Discussion have been held about the most appropriate type of label and it is felt that 'standard' black plastic botanic garden labels would be best, even though there are some concerns about sustainability.

The aim must be to label every single plant. However, to start with established (ie growing well and not likely to die) trees and shrubs, starting from the entrance will be selected as a priority. The proposal is that labels will be produced in batches of 50-100. Herbarium staff are asked to help ensure the correct identity of specimens. Label information will include:

- Common name
- Latin name
- Family
- Accession number
- Year planted in the garden
- Altitude the plant grows at (for Bhutanese plants)
- Country of origin (for non Bhutanese plants)

Labels should be attached to trees/shrubs with copper wire and these wires should be inspected annually to ensure they are not cutting into the wood (if they are the wire should be loosened).

Minimum standards of information and record keeping

In the first few years after foundation it was understandable that the focus of activity was devoted to collecting and establishing plants in the garden. At this time, then, relatively little time was devoted to collection information and plant records. However, as time progresses more time must be devoted to records as they are the major factor that distinguishes botanic gardens from other types of garden. Furthermore, plants in botanic gardens are only useful to scientists if they are fully recorded and so it should be possible to find out a wide range of information for each plant in the collection.

In due course a set of minimum standards should be set for plants entering the botanic garden collection and if plants do not have this information then they should be rejected. As the garden develops and matures it should be possible to move from collecting a lot of plants with little information to fewer plants with more information.

Minimum standards could include the following:

- Name
- Family
- Date collected
- Name of collector
- Collector's number
- Altitude
- Aspect
- Other vegetation in vicinity
- Habitat type
- Collected by seed, cutting, whole plant etc

Other information can be added, and the more the better, but the garden needs to establish what it considers to be the minimum acceptable amount of information. This information should then be stored electronically (currently BG Recorder) and staff (more than one) should be trained in data entry and retrieval.

Mnimum standards of cultivation

The cultivation and maintenance of the plants in the collection is paramount. If the plants die or look sickly or if the garden is weedy and untidy then nobody will visit and the purpose of the garden will be questioned. RBGS is, of course, still very young and developing at a fast rate. It will not be possible to have the garden looking immaculate for some years to come but it should be possible to strive for certain minimum standards now. These could include:

- 90% of plants entering the collection to be grown from seed by 2005
- Plants collected directly from the wild to be less than 1m tall
- Weeds to be removed from all tree bases
- Tree bases and flower beds to be mulched with organic matter every 3 years

- Weeds to be kept from paths
- Beds to be kept weed free
- Lawns to be mown once a week in growing season
- Rough grass to be cut once a month in growing season
- All piles of stones, gravel and unwanted material to be removed from site
- Paths (especially main path and entrance) to be swept once every 2 weeks
- Car park area to be kept neat and tidy
- Hedges by paths to be cut once a year
- Herbaceous planting to be planted densely where appropriate to suppress weeds
- Bins to be emptied at least once per week or when full
- Flower bed edges by lawns to be cut neatly

Interpretation

Plants, on their own, offer little more than simple beauty. Interpretation is the means by which the public can learn more about plants, find out their qualities and appreciate why they have been planted. However, to work well the collections must compliment and ‘help’ the interpretation. When considering interpretation thought should be given to the plants that can be used to support the storey/message being given. Once selected and planted it is essential that the plants stay in place, are not moved, or are replaced if they die. There is nothing worse than an interpretation panel giving some information about a plant that no longer exists.

Acquisition Policy

Having now considered all the objectives, users, limitations and aspirations for the garden in general the acquisition policy is now in a position to start listing the types of plant that should be acquired for the collection over the next 5-10 year period. These are listed in general here with more detail being provided in the appendices.

General acquisition themes:

- Bhutanese native plants capable of growing at RBGS (multiple wild origin accessions where possible), not falling into Thematic areas (Appendix I)
- Plants for thematic plantings listed above (Appendix II)
- A small number of exotic plants grown for specific purposes (listed above) (Appendix III)
- A small number of annual cultivars for display
- Conservation collections (once list of rare/endangered species compiled)- need to be genetically structured
- Plants to compliment interpretation themes and panels

Appendices not included in this report to save space

APPENDIX III. Report and recommendations following horticultural training visit by Peter Baxter and Clare Morter

Royal Botanic Garden Serbithang

May 2004

Glasshouse

Following the work done by Tony Garn and Brian Cunningham to landscape the glasshouse and ameliorate the soil, one of the objectives of this visit was to establish the planting of this area.

Plant collection

Collection for the new glasshouse took place over a weekend visit to Phuntsholing. Sangay Dema, Ngawang Gyeltshen, Sonam Tobgay, Sithar Dorji and 5 labourers made the journey. Whenever possible future visits could include the horticulturists responsible for the glasshouse.

Plants were rootballed and left in the field overnight for collection the next day. Initially plants were covered with a plastic sheet and transported on the back of an otherwise open vehicle. A cover was later built over the back of the vehicle much improving the conditions for the plants in transit and it was suggested that a pump sprayer could be used to mist the plant material more frequently during the journey. Good rootballs were often difficult to achieve due to shallow soils and precipitous growing positions. It was also suggested that foliage should be reduced at the time of collection to reduce stress.

Once back to RBGS the plants were unloaded into direct sunlight outside the glasshouse. Perhaps a temporary shaded area should be provided at the place where the collections are offloaded from the vehicle. Although planting took place immediately, already stressed plants were now subjected to full sun in the glasshouse, a drying wind and no misting facility. Future collections could make use of the shade tunnel in the nursery area as a temporary holding area for plants to acclimatise.

Collecting notes were taken and should be permanently linked to the planted material. Herbarium specimens should similarly be made. Notes should in future contain such additional information as soil type, aspect and associated species.

Propagation / growing on

It was important to get the glasshouse planted before the opening day in July. There are likely to be losses to the collection but now that there is at least some material in the house more could be acquired and grown on in pots in the shade tunnel at the nursery during the summer. Some surplus plant material has already been taken there and is showing much better condition. In the initial stages there can be a concentration on more easily grown species like gingers, Araceae and some ground cover plants which can be easily propagated over the summer for autumn planting. These will help to maintain higher humidity while 'greening' the house. Consideration should be given to the utilization of all dimensions of the glasshouse space.

Watering

This is seen traditionally as an unskilled job and is the responsibility of one of the labourers. There are many variables involved in watering and it is important that these are understood by staff at all levels. On a practical level there should be some improvements. The standpipe has still to be moved to the door of the glasshouse as suggested by Tony. A watering lance is fine for general use. A mist attachment similar to the one used in the Orchidarium will achieve the finer mist required for the artificial trees and for flagging foliage. A 20m length of hose and geka fittings/sprays would make for easier use and once plants are established, layflats would be useful. These were delivered in July.

Shading

Shading for the glasshouse is essential. Light levels are extremely intense and damaging, possibly for most of the year. White paint was applied to the sides and roof with immediate benefit. Samples of various shading materials with indications of light reduction and energy efficiency levels were taken for consideration for use in the future. Some climbers have already been planted and more may be added to provide a natural and seasonal shade.

Ventilation

Windows in the traditional style do not have fasteners. The prevailing wind gets straight into the house and there is evidence of breakage. A chain and hook would be sufficient to safely fasten the vents and any broken glass should be replaced immediately. Although good ventilation is required a net frame could be made for the doorway to reduce the drying effect of the wind which seems to blow in each afternoon - not an attractive solution but it could easily be removed in less windy seasons.

Temperature monitoring

There are no available meteorological records for Serbithang. A maximum/minimum thermometer would be a useful indicator in the glasshouse and records would provide a good reference point when considering cultivation requirements. A minimum 12 – 15°C should be maintained with electric heaters to provide winter backup. Choice of shading material would influence thermal loss during the winter months.

Artificial trees

Epiphytes (largely orchids) were brought in for the artificial trees following a visit to the SW by Ngawang Gyeltshen, and were attached by Tshering Wangmo and Wangmo Moitra over a base of moss. These will need particular attention from Sithar Dorji. Shade and misting is critical to the well being of these plants. Very soon too a programme of feeding will need to be established, as it will for the whole house once plants begin to grow.

Planting plan

Plant selection in a glasshouse of this size must be carefully considered. Perhaps at this stage it is too much affected by unpredictable survival rates but ultimately there should be a plan to make best use of a very limited space.

Area of garden below the glasshouse

Ideas were requested for the area immediately below the glasshouse. The area included the rock garden created by Tony and Brian, an area with Bhutanese 'sculptures' and a very dry, unimproved area with remnants of stone from other projects to the left of the path from the garden entrance towards the glasshouse. I suggested breaking the area into the following – the intention being to bring about a reduction in scale from the wider landscape to the rock garden thereby creating a focus for the detail of the alpine plants.

The whole area was very weedy and time was spent with TW and WM as well as the labourers in careful weeding. Emphasis was placed on the need to maintain hand weeding especially on the rock garden and a series of stepping stones were put in place to give access for weeding by TW.

Rock Garden

A collection of plants from Cheli La, 3810m was made by Sangay Dema, Sonam Tobgay, Tshering Wangmo, Wangmo Moitra and labourers. Turf rather than individual plants were collected. This may prove difficult to maintain at Serbithang and plants will need to be closely monitored and checked against the local climate to assess what could be collected on future visits. Collections should include seed which could now be successfully raised in the nursery. Use can be made of small shrubs throughout the rock garden to give structure, reflecting those seen on the way to Cheli La – Piptanthus, Juniperus, Berberis, Indigofera and Rhododendron.

Compositae

There is a desire to escape from the old concrete edged flower beds and this is an area which could be used to represent some of the Compositae from the Bhutan flora while providing a large and naturalistic planting of colour. There are many Compositae included in the medicinal plants of Bhutan – these could well be included in the future in a trail designed throughout the garden. Many species are immediately available, all are easily grown and ultimately maintenance of this area would be low to offset that required in the rock garden. Winter structure could be added by the planting of shrubs and small trees and a suggested plant list was left with Sangay.

Bhutanese 'sculptures' - Bamboos and grasses

This area already has structure of a type from the stone built 'sculptures'. Since there is no representation of grasses within the collection I suggested their use here along with some of the smaller bamboos. There is the advantage too that these are readily available and easily grown and maintained. There are significant numbers of grasses of economic importance which could be interpreted for the visitor and there is good ecological value attached. Plant list supplied to Sangay.

Clare Morter

August 2004

APPENDIX IV. Report and recommendations following horticultural training visit by Peter Brownless and Ross Irvine.



**Report on training visit to
Royal Botanic Garden, Serbithang, Bhutan. Propagation and
nursery construction
Second visit July 2004**



*Peter Brownless & Ross Irvine,
The Royal Botanic Garden, Edinburgh.*

Visit 2nd to 13th July 2004, Peter Brownless (Garden Supervisor, Nursery) and Ross Irvine (Senior Horticulturalist, Nursery).

Work Plan (David Rae, Director of Horticulture)

- Discussions with building engineer to finalise nursery construction/ answer any questions.
- Rerun propagation workshops to reinforce learning (seed sowing, cuttings, compost etc)
- Prick out/pot up seedlings/cuttings from last year's workshops.
- Discuss mist propagation and nursery label machine.
- Provide general advice and landscaping work in the garden as time permits.
- Undertake some collecting for the garden.
- Using the Flora of Bhutan make suggestions for suitable plant content for a number of beds/areas (as time permits).

Report on activities

Discussions with building engineer to finalise nursery construction/ answer any questions.

Discussions were undertaken with Sangay Dema about the development of the propagation house in the nursery, the plants from the developer were reviewed.

(see appendix one).

- RBGE can give further assistance remotely as work commences on this contract.

Rerun propagation workshops to reinforce learning (seed sowing, cuttings, compost etc). Prick out/pot up seedlings/cuttings from last year's workshops. Undertake some collecting for the garden.

Two days were spent on reinforcement of propagation techniques as per 'Nursery construction, nursery practice and the propagation of Bhutanese Plants A practical training manual for the Royal Botanic Garden, Serbithang, Bhutan' issued to the garden staff in 2003. There had been a high level of success in the germination of seed that sown and cuttings which had been taken in 2003. There was strong evidence that the manual is used and that techniques have been retained and passed on to other staff. The material developed was used to demonstrate potting up. Further cuttings were taken and seed sown, from material collected in the garden. Use was made of the label printer to correctly label the material and record sheets were completed. A set of seeds collected in 1984 by Sinclair and Long, from the germplasm store at RBGE was sown. Though this seed is quite old, it is hoped that it will give some germinations. The labels produced from these seeds have RBGE accession numbers on them; a full set of records from RBGE BG-BASE was left. Many are alpine species particularly suitable for planting in the Rock Garden. It was not possible to collect any material from the wild for the garden.

(see Appendix two).

- It is important that further reinforcement of the importance of recording collection, propagation and planting is made by J. Latta and R. Cubey.
- It is suggested that seed could be collected from Bhutanese plant material being grown at RBGE and returned to RBGS.

Discuss mist propagation and nursery label machine.

As it was not possible to install the mist unit, the installation was discussed in detail with Sonam. A full set of instructions were left with the parts. The label printer was successfully installed and demonstrated on one of the computers.

(see appendix three).

- It is important that the label machine is available for use to all in the garden to allow maximum use and establish a high standard of labelling.
- RBGE can offer remote support when the mist unit is installed.
- RBGE can offer remote support for the label printer; assistance may be needed when the stock of labels left is depleted.

Provide general advice and landscaping work in the garden as time permits. Using the Flora of Bhutan make suggestions for suitable plant content for a number of beds/areas (as time permits).

Two areas were studied in detail, the Medicinal Garden and the Rose Garden. General recommendations were made on a number of aspects of maintenance and construction, during a series of walk rounds with RBGS staff. (see appendices four, five and six).

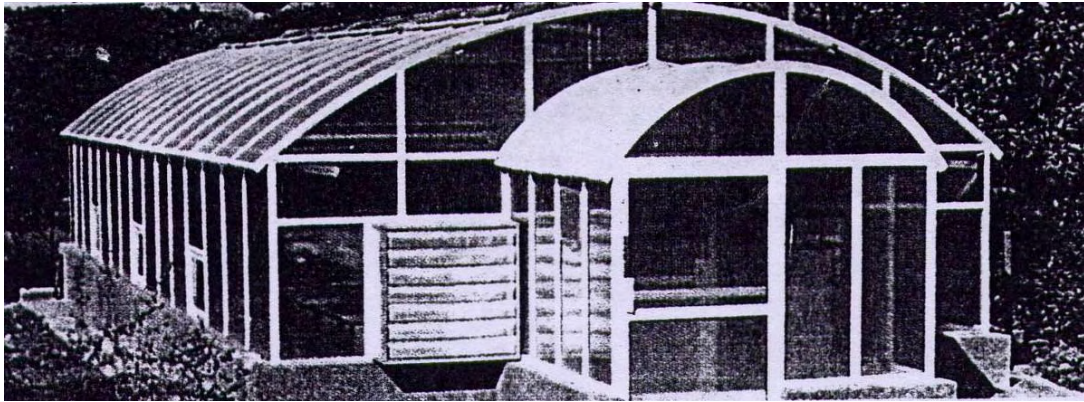
- The areas suited in detail and the development of an over all electronic version of the plan of the garden will help J. Latta and R. Cubey in the recording of the gardens collection.
- The volume of work generated by any recommendations made for this site, must take into account the human and financial resources that are available. But stand as recommendations that can be adopted and developed in any future development plans as resources permit..

Discuss sundial construction implementation (Queen's garden).

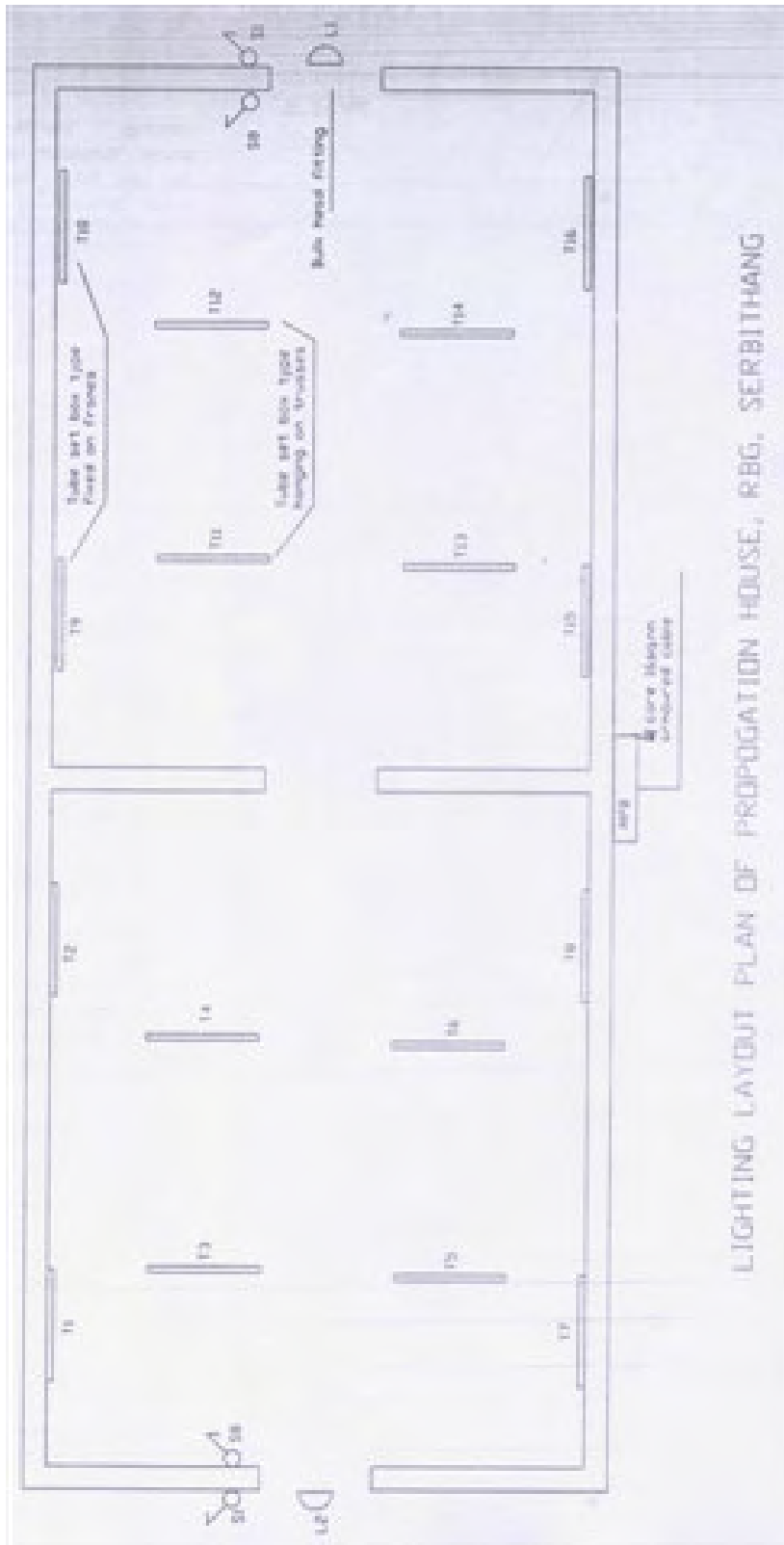
Illustrations of various sundials from Europe we discussed for their suitability as Bhutan's first sundial. Models were constructed to demonstrate how a sundial works and to check accuracy. A design was finalised. A site visit was undertaken. A marble base and gnomon was purchased and marked out for hours. Artistic embellishments were discussed. (see appendix seven)

RBGE can offer further remote assistance if needed.

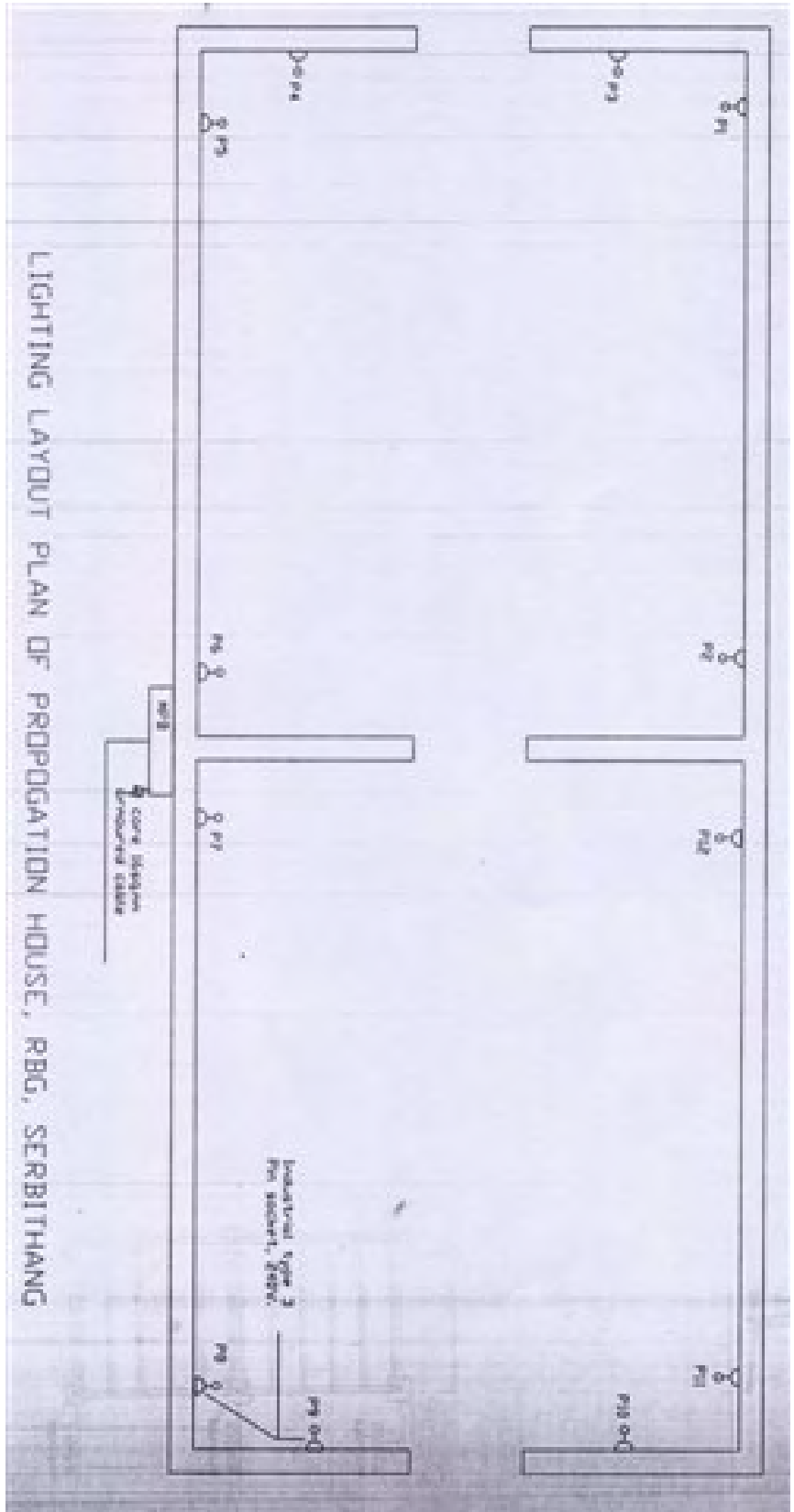
Appendix 1
Propagation House specification.
1st July 2004



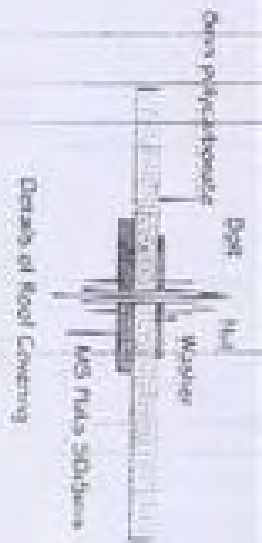
A similar structure



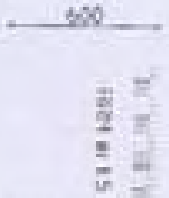
LIGHTING LAYOUT PLAN OF PROPOGATION HOUSE, RBG, SERBITHANG



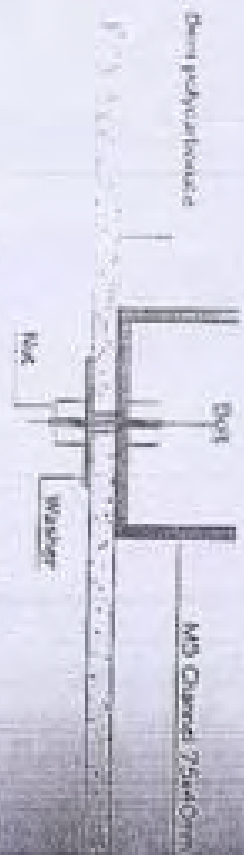
LIGHTING LAYOUT PLAN OF PROPOGATION HOUSE, RBG, SERBITHANG



Stone thickness 100 mm.



Foundation of Stone Wall



Concrete foundation 1200x1200 mm
Stone 300mm x 300mm thick

Stone thickness 100 mm
Stone wall depth 1500 mm

Drawn By:-
Layonee Deydas

Checked By:-
Bijoy Kumar Das

Approved By:-
Sudipta Ranjan Das

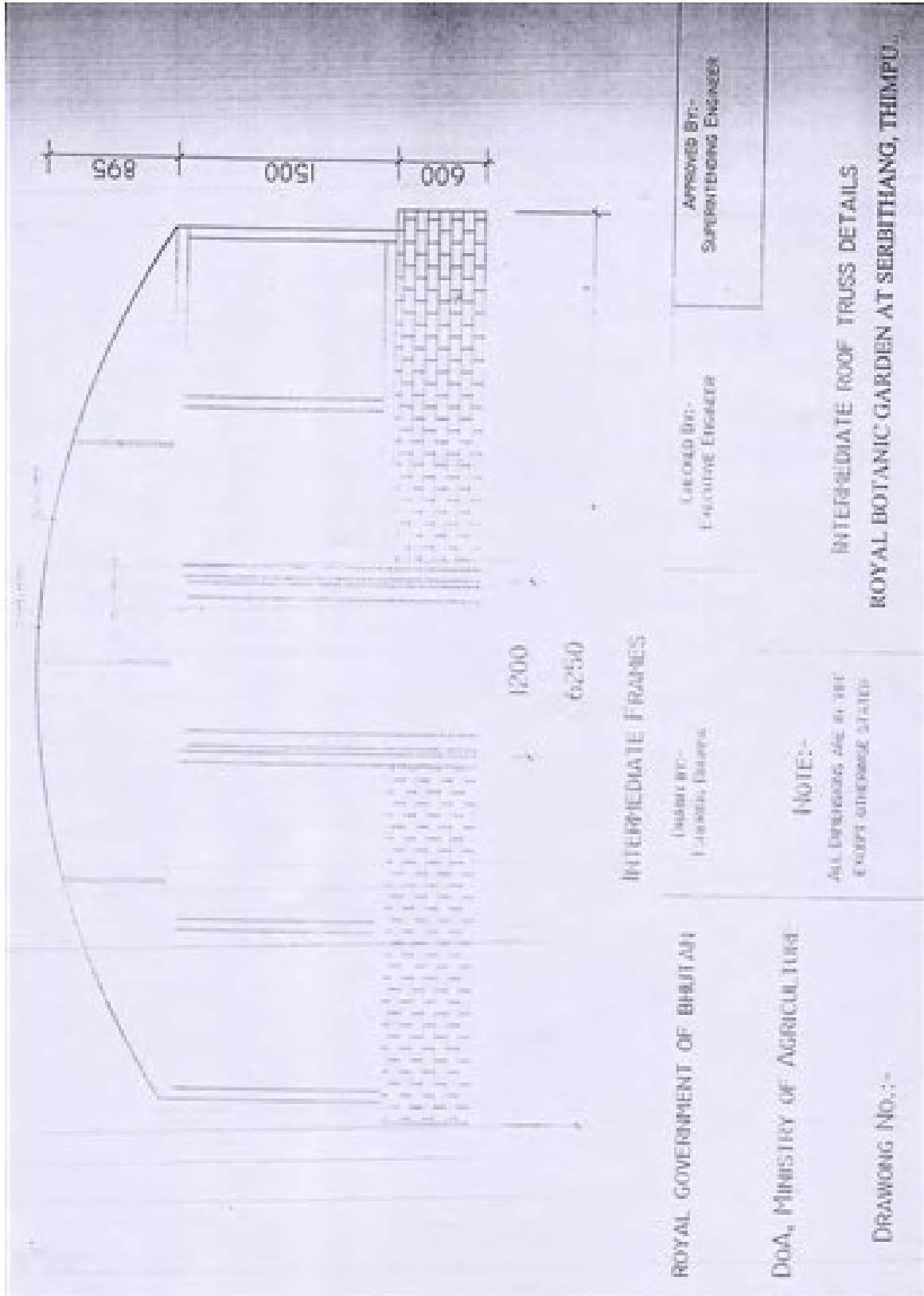
DDA, MINISTRY OF AGRICULTURE

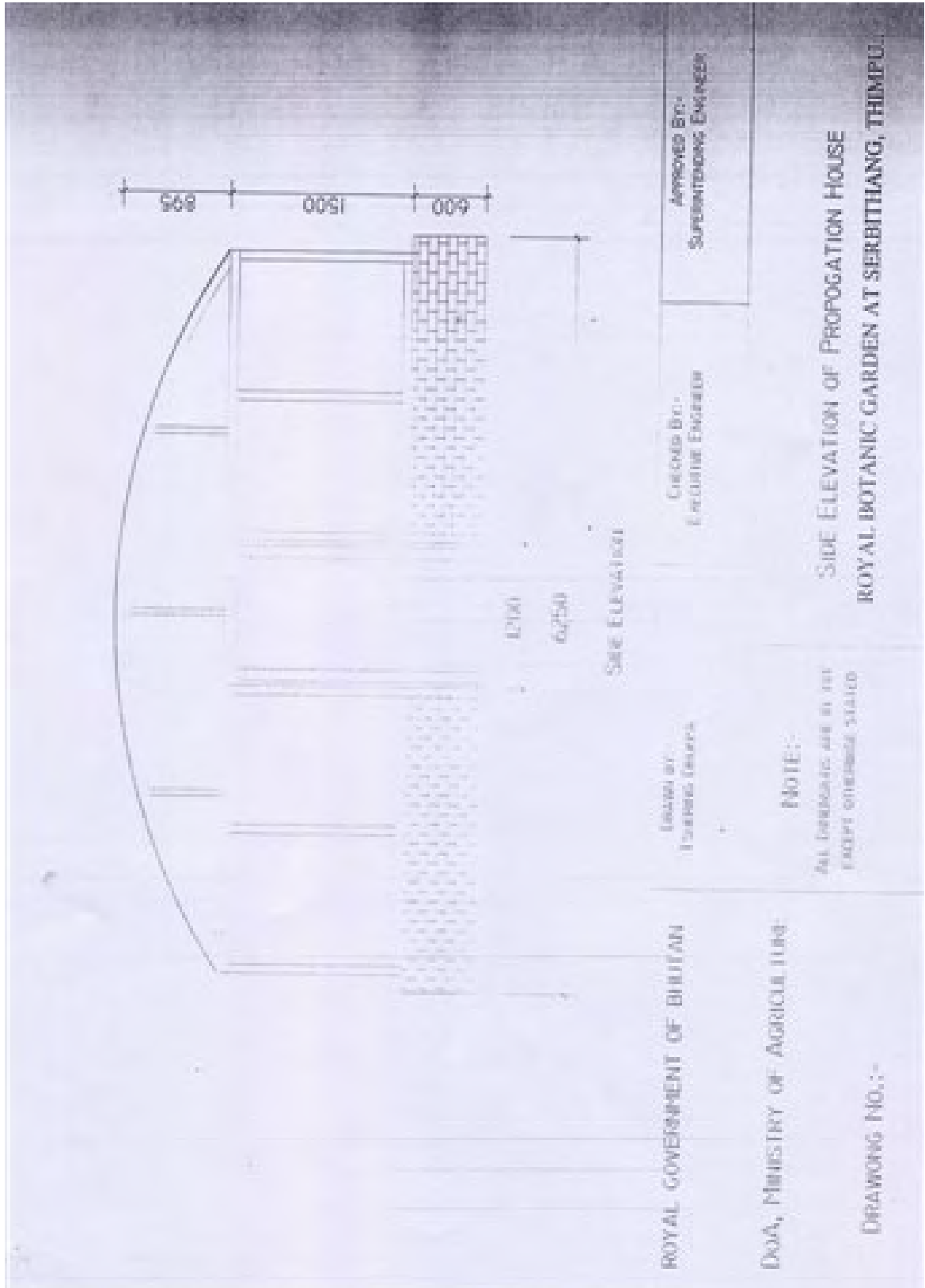
DRAWING NO.-

NOTE:-

All dimensions are in mm
except otherwise stated

DETAILS OF FOUNDATION & POLYCARBONATE FIXATION
ROYAL BOTANIC GARDEN AT SERBITIANG, THIMPHU

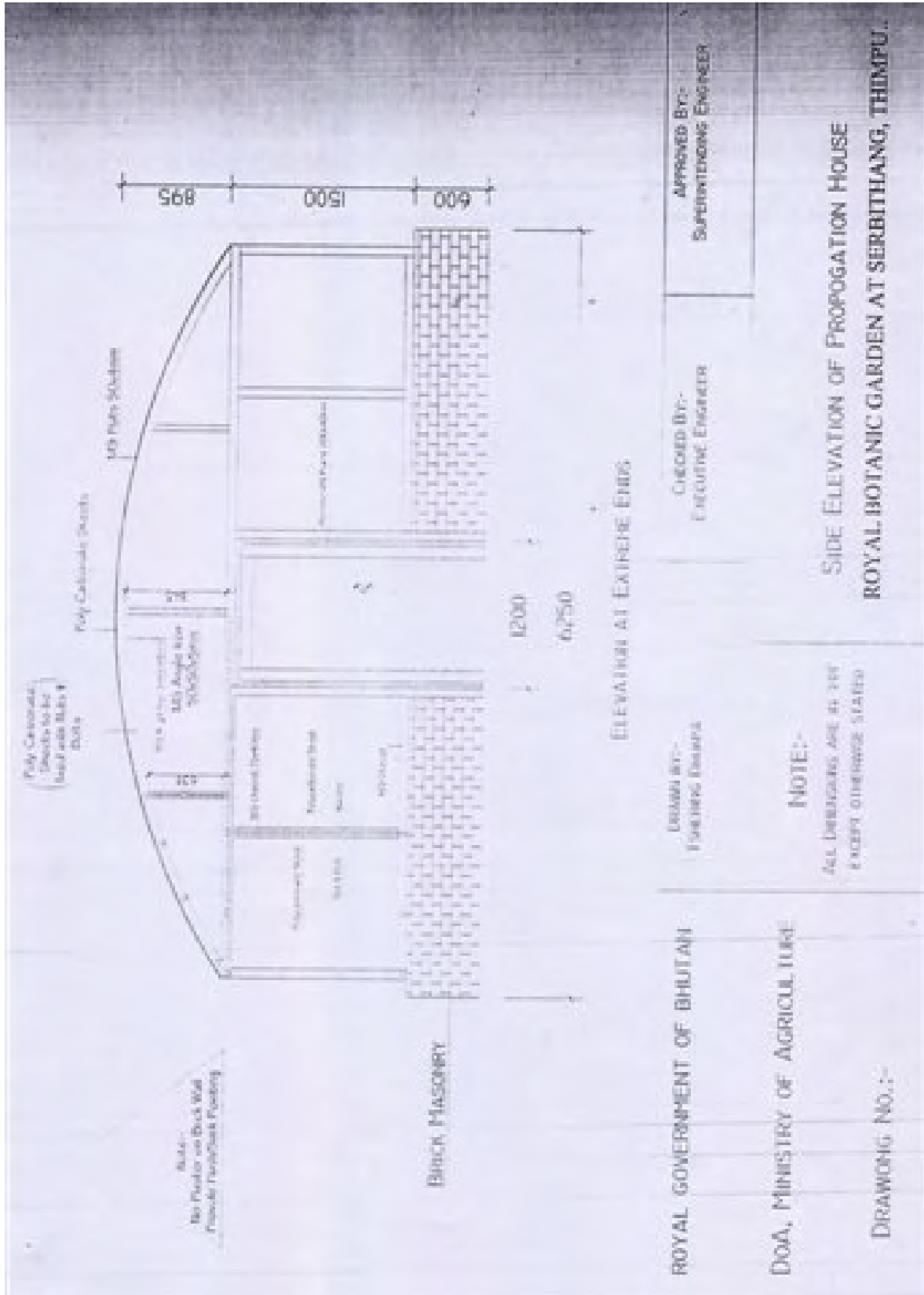


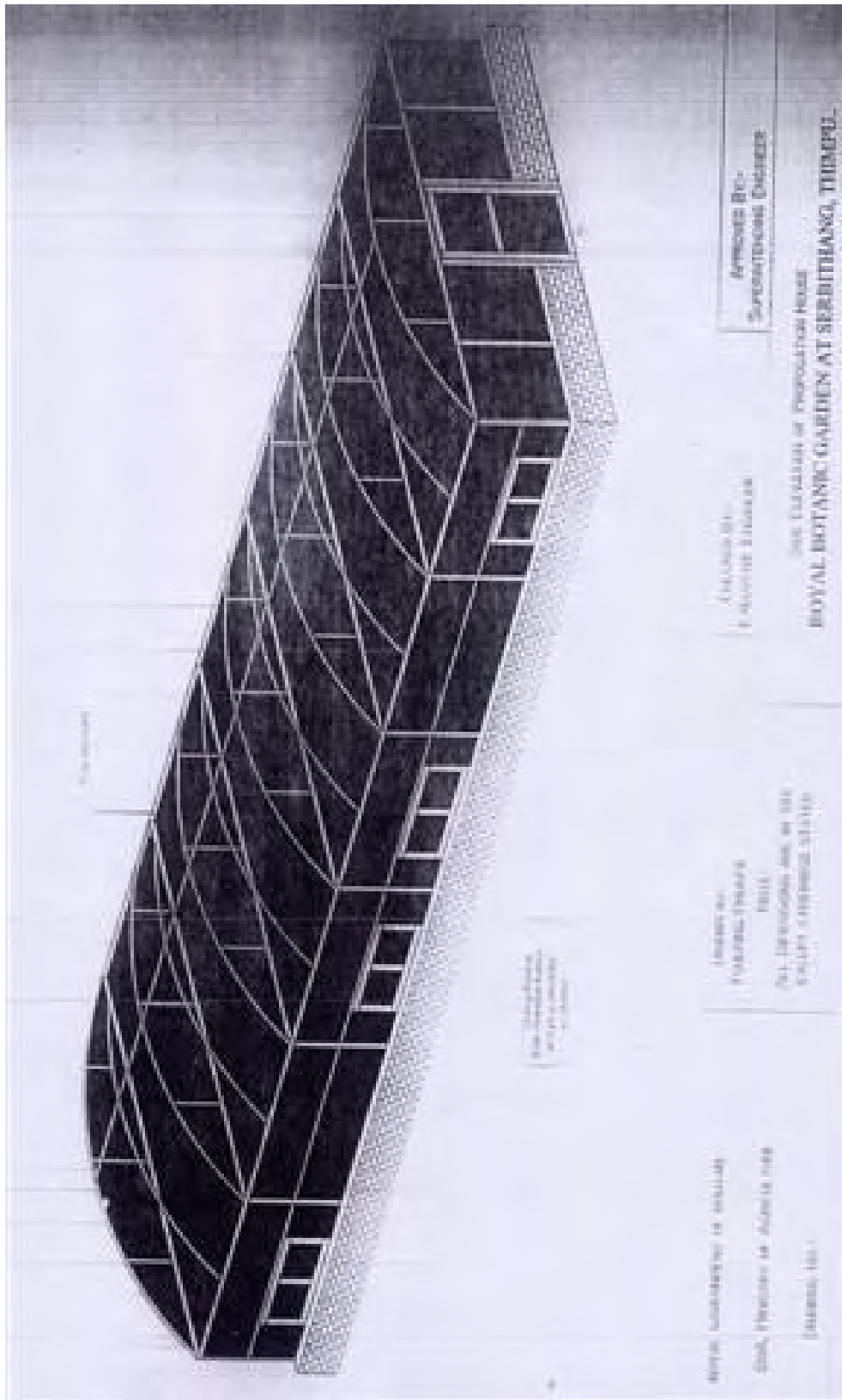


ROYAL GOVERNMENT OF BHUTAN

DOA, MINISTRY OF AGRICULTURE

DRAWING NO. :-





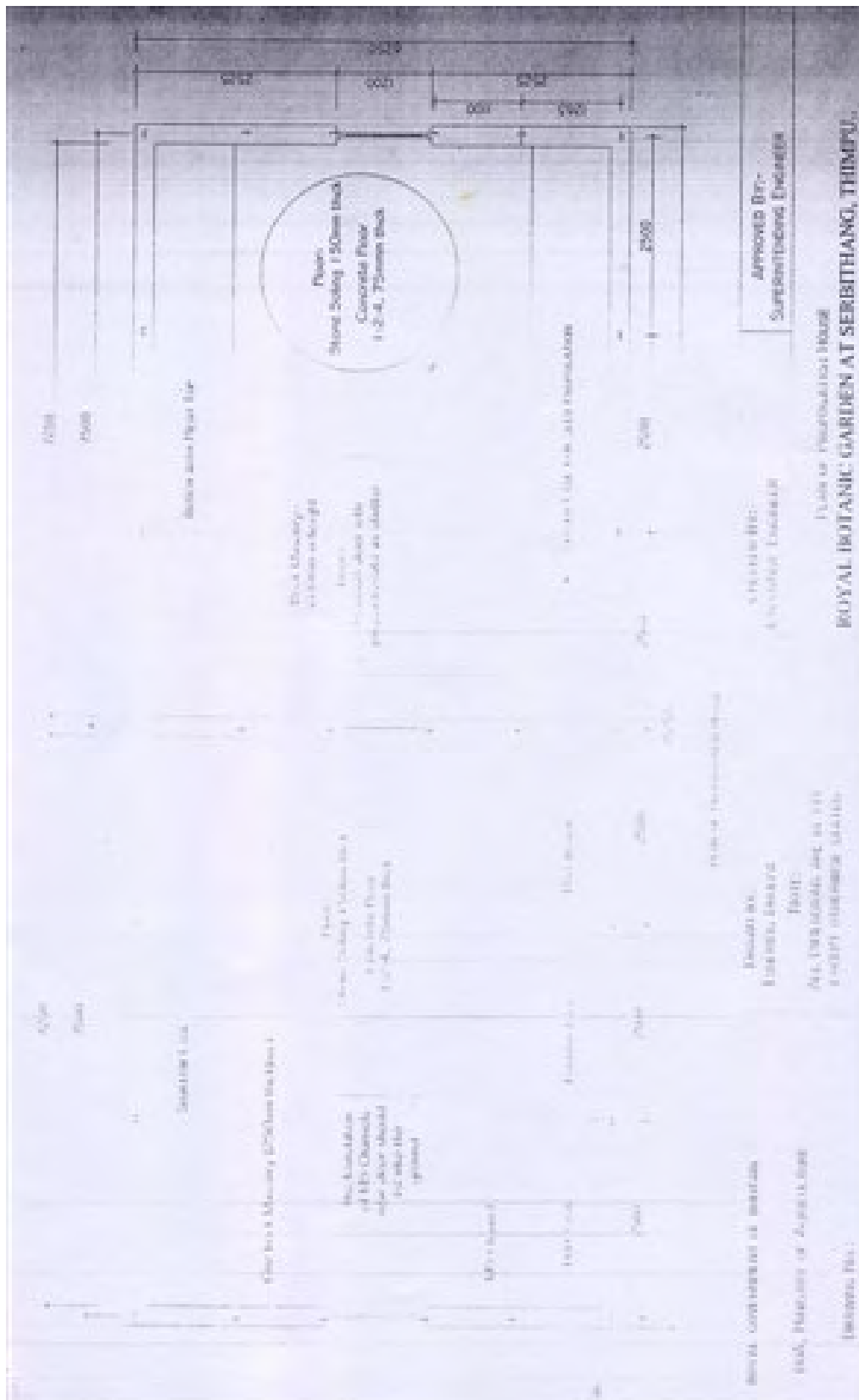
Arsitektur Botani
Sudjawan, Cirebon

Arsitektur Botani
Pusat Penelitian dan Pengajaran

Arsitektur Botani
Pusat Penelitian dan Pengajaran
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Arsitektur Botani
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Pusat Penelitian dan Pengajaran
Pusat Penelitian dan Pengajaran

Desain, Penelitian dan Pengajaran Pusat
ROYAL BOTANIC GARDEN AT SERBITBANGSO, THIRUPU.



12	P/D 4 core 25sq mm armoured cable MPB to SB1, SB2, SDB3, SDB4	70	m
14	Providing and fixing Bulk head fittings with 100w lamp, excl lamps.	2	each
15	Providing and fixing Incandescent bulb 60W (Philips)	2	each
16	Providing and fixing Fuse Switch Unit 63A, TPN, wall mounting, 415V complete incl T&C & fuses.	1.00	each
17	Providing and fixing Bus bar Chamber 4 Strip 450mm bar 200A	1.00	each
18	P/F switch socket with indicator 16A, 240v Anchor make incl. PVC molded case box.	12.00	each
23	Hand excavation and refilling for under Ground cable 95sq.mm incl earth excavation, sand filling with brick bats and refilling of excavated earth.	55.00	mts
24	P/F heavy duty brass compression gland for 3.5 core cable 29mm dia for 25sq mm	1.00	each
25	P/F Aluminium thimbles (lugs) 25sq.mm cable	8.00	each
26	P/F earthing plate 60X60X6mm complete. incl. Excavation, charcoal, salt, plate etc.	1	each
27	P/E connection to earth plate	12	m
28	Looping earthing	130	m
29	P/F Wooden board incl all necessary hinges, painting locking arrangements and with shutter.	1	each
	Total:-		
	Add 13.25% Cost Index		
	Total:-		
	SAY:-		

Ngultrum (Seventy seven thousand seven hundred sixty four) Only

Electrification of Propagation House, Royal Botanical Garden, Serbithang.

Sl No	Description of work	Qty	Unit	Rate	Amount
1	Wiring Lighting , Exhaust Fan with PVC wire copper, single core 1.5sq mm in M.S conduit, surface/recessed steel conduit, incl connections, testing and commissioning etc complete excl the cost of M.S conduit. Short Point	2	m		
	Medium Point	8	m		
	Long Point	8	m		
2	P/D 2x2.5sqmm PVC, 1.1KV grade from SDB to control switches incl. all necessary joints and conduit in surface/Recessed steel conduit.	55	m		
3	P/D 2x4sqmm copper wire for Power point wiring, in excess length above long point incl. necessary joints and conduit in surface/recessed PVC conduit Short Point	135	m		
5	Providing and fixing Tube sets 1X36/40w, 1200mm strip rail type.	16	each		
6	Providing and fixing ceiling rose 6Amps.	18	each		
7	Providing and fixing Tube rod 1X40w, 1200mm single rod (Philips)	16	each		
8	Providing and fixing single way switches 5A, 240V (Anchor) incl PVC molded case box.				
	single way switches	2	Nos		
	4 ways, single way switches	2	Nos		
9	Providing and fixing MCB 6A for lighting	9	Nos		
	25A for Power	15	Nos		
10	P/F Isolator 63A TPN. (Havells)	1	each		
11	P/F steel distribution board TPN, single door type.				
	8Ways SPN	1	each		

BOM of Brick Masonry for Green House at the Royal Hospital Garden, Serloham.						
Sl. No.	Description of Works	No	Length (m)	Breadth (m)	Height (m)	Quantity Unit Rate Amount
1	Excavation in excavation area with > 200mm width > 1.5 m, area 7.10 sq.m. in area including disposal and neat dressing of excavated earth within 50 m least and 1.5 m ft.	1	20.00	12.00	0.60	144.00 m ³
2	Earth work in excavation in foundation trenches with > 1.5 m, area 10 sq.m. on plan, including dressing & ramming, disposal and neat dressing of excavated earth within 50 m least and 1.5 m ft. LW	2	15.00	0.80	0.60	18.00
	Steel	3	3.40	0.80	0.60	5.80
						17.00 m ³
3	Filling of trenches, sides of foundations etc. in layers < 200 mm using selected excavated earth, ramming etc. within 50 m least & ft 1.5 m. Foundation sites	4	15.00	0.70	0.40	2.50
		6	3.40	0.70	0.40	1.30
						3.79 m ³
4	Providing and laying 15cm thick hard packed stone setting LW SW	2	15.40	0.60	0.15	2.77
		3	3.40	0.60	0.15	1.40
		1	7.28	0.75	0.15	12.67
						16.74 m ³
5	Providing and laying RRM with hard stone in foundation and joints in cement mortar 1:4	3	15.40	0.40	0.40	4.93
		1	3.40	0.40	0.40	1.73
						6.66 m ²
6	Providing and laying PCC 1:2:4, 20mm aggregates excluding the cost of centering and shuttering in foundation and joints.	3	15.40	0.60	0.60	0.90
		1	3.40	0.60	0.60	0.49
						1.41 m ³
7	Providing and laying cement concrete flooring 1:2:4 finished with a floating coat of neat cement, 20mm aggregates, 15mm thick.	3	7.28	0.75	-	63.30 m ²
8	Providing and laying Second class brick work in foundation and joints in cement mortar 1:4.	2	15.28	0.60	-	18.30
		3	4.93	0.60	-	8.19
	Shallow Case	4	0.60	0.70	-	1.68
		1	7.28	0.70	-	5.08
	Bench with Mesh Top	4	0.60	0.70	-	1.68
	Closed Case	1	7.28	0.70	-	5.08
		4	0.60	0.70	-	1.68
	Deep/gradient cases	4	0.60	0.70	-	1.68
						41.36 m ²
9	Pointing on brick work with cement mortar 1:3. Flush pointing.	2	15.28	0.60	-	18.30
		3	1.55	0.60	-	4.95
	Shallow Case	6	0.60	0.70	-	2.52
		2	7.28	0.70	-	10.13
	Bench with Mesh Top	6	0.60	0.70	-	2.52
	Closed Case	1	7.28	0.70	-	5.08
	Deep/gradient cases	6	0.60	0.70	-	2.52
						47.68 m ²

		Sheet				
10	Providing and fixing centering and shuttering including propping, strutting and removal of formwork in RCC Slabs.	2	7.25	5.75	-	83.38
		2	8.45	0.08	-	1.27
						84.64 m2
11	Providing and fixing steel reinforcement for RCC work including cutting, bending, placing and binding in position in complete. RCC Slabs 12 dia. @ 150 c/c bothways as top and bottom reinforcement.	98	0.75	0.89	-	65.42
		10	7.25	0.89	-	64.53
						129.94 kgs
12	Providing and laying RCC 1:2:4, 20mm aggregates excluding the cost of formwork and steel reinforcement in complete.	2	7.25	5.75	0.08	6.25 m3
13	Providing and fixing welded wire mesh including beading in complete.	1	7.25	0.60	-	4.35 m2
14	Providing and applying aluminum paints, two coats over the welded wiremesh.	1	7.25	0.60	-	4.35 m2
	Add 13.24% Cost Index					
	grand total:					

Appendix 2 Propagation



Germinated seedlings, sown October 2004.



Rooted cuttings, taken October 2004.



Cuttings taken July 2004.



Sallow trays used, seed sown in drills.



Potting up rooted cuttings.



Preparing cuttings.

APPENDIX 2

Seed taken to RBGS from RBGE

- 19841905 *Silene gonosperma* (Rupr.) Bocquet ssp. *himalayensis* 12 Nov 1984
Our source: 630 (= Sinclair & Long)
collected directly from wild; origin known
Bhutan: Upper Mo Chu Dist.: Valley SW of Lingshi Dzong. 4040
m. 27°55'N, 89°26'E. Amongst scrub on steep hillside. Erect
herb with tuberous roots, in fruit. Sinclair, I & Long, D
5412. 29 Sep 1984.
- 19841849 *Rheum acuminatum* Hook.f. & Thomson ex Hook. 12 Nov 1984
Our source: 630 (= Sinclair & Long)
collected directly from wild; origin known
Bhutan: Upper Mo Chu Dist. Hillside above Laya. 4130 m.
28°7'N, 89°44'E. Amongst shrubs in block scree. Herb;
fruiting panicle up to 1 m. Sinclair, I & Long, D 5182. 20
Sep 1984.
- 19792534 *Primula erythrocarpa* Craib 6 Sep 1979
Our source: 327 (= Grierson & Long)
collected directly from wild; origin known
Bhutan: Thimphu Dist.: Taba, Thimphu. 2350 m. 27°30'N,
89°38'E. Damp ground by stream. Flowers mauve with yellow
eye, variable in colour. Grierson, A & Long, D 921. 9 May
1979.
- 19841877 *Lilium nanum* Klotzsch 12 Nov 1984
Our source: 630 (= Sinclair & Long)
collected directly from wild; origin known
Bhutan: Upper Mo Chu Dist.: East bank of Tharizam Chu. 4150
m. 28°1'N, 89°35'E. Grassy hillside amongst shrubs and
boulders. Bulbous herb in fruit; capsule striped brown and
white. Sinclair, I & Long, D 5296. 24 Sep 1984.
- 19841784 *Codonopsis viridis* Wall. 12 Nov 1984
Our source: 630 (= Sinclair & Long)
collected directly from wild; origin known
Bhutan: Upper Mo Chu Dist.: Tamji to Goen Gaza. 2340 m.
27°52'N, 89°45'E. Climbing over shrubs on steep bank.
Twining herb; flowers unpleasantly scented, calyx green,
corolla cream, lobes purplish-crimson and streaked within.
Sinclair, I & Long, D 4962. 13 Sep 1984.

- 19841895 *Anemone rupicola* Cambess. 12 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: Gangyuel Chu, below Gangyuel.
 3680 m. 27°56'N, 89°29'E. Amongst scrub on N-facing river
 bank. Erect herb in fruit. Sinclair, I & Long, D 5375. 27
 Sep 1984.
- 19841743 *Delphinium stapeliosmum* Brühl ex Huth 8 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Thimphu Dist.: Dechhenphu, N of Thimphu. 2480 m.
 27°32'N, 89°38'E. In cleared *Pinus wallichiana* forest
 amongst *Artemesia*, etc. Erect rhizomatous herb; flowers dark
 purple. Sinclair, I & Long, D 4814. 5 Sep 1984.
- 19841728 *Anemone rivularis* Buch.-Ham. ex DC. 8 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Thimphu Dist.: Summit of Dochong [Dochu] La. 3080 m.
 27°29'N, 89°45'E. On roadside bank in partly cleared *Tsuga*
 forest. Herb in fruit, 60 cm. Sinclair, I & Long, D 4769. 1
 Sep 1984.
- 19841900 *Oxyria digyna* (L.) Hill 12 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: Pass between Gangyeul & Lingshi.
 3990 m. On wet rocks by stream in shady ravine. Sinclair, I
 & Long, D 5387.
- 19841951 *Cathcartia villosa* Hook. 12 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Punakha Dist.: E side of Dochong [Dochu] La. 3060 m.
 27°29'N, 89°45'E. Bank of small ravine in *Tsuga* forest.
 Perennial herb 70 cm, in fruit. Sinclair, I & Long, D 5574.
 10 Oct 1984.
- 19841907 *Cavea tanguensis* (Drumm.) W.W.Sm. & J.Small 12 Nov 1995
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: Valley SW of Lingshi Dzong. 4040
 m. On shady gravelly bank amongst shrubs. Sinclair, I &
 Long, D 5423. 29 Sep 1984.

- 19860780 *Pterocephalus hookeri* (C.B.Clarke) Diels 1 Jul 1986
 Our source: 1094 (= Peck, Lady)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: Ablation Valley, above Lingshi.
 4200 m. Peck, Alison M.M. 29. 17 Oct 1985.
- 19841788 *Piptanthus nepalensis* (Hook.) D.Don 12 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: Near Gaza Dzong. 2800 m. In
 scrub in open hillside. Sinclair, I & Long, D 5002. 14 Sep
 1984.
- 19841119 *Primula rosea* Royle 10 Jul 1984
 Our source: 197 (= Chadwell, C.)
 collected directly from wild; origin known
 India: Kashmir. Chadwell, C., Howard, D., Powell, A. &
 Wright, N. 42.
- 19841852 *Meconopsis paniculata* (D.Don) Prain 12 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: Hillside above Laya. 4230 m.
 Amongst block scree with scattered shrubs. Sinclair, I &
 Long, D 5198.
- 19841867 *Meconopsis paniculata* (D.Don) Prain 12 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: Valley below Phoudingi. 4320 m.
 On disturbed soil on grassy river bank. Sinclair, I & Long,
 D 5261.
- 19841861 *Cortiella hookeri* (C.B.Clarke) C.Norman 12 Nov 1995
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: Ridge above Laya. 4500 m. In
 rocky gully on S. facing cliff on scree slope. Sinclair,
 I.W.J. & Long, D.G. 5245.
- 19841790 *Neillia thyrsoflora* D.Don 12 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: Gasa Dzong. 2800 m. 27°55'N,
 89°46'E. In scrub on open hillside. Shrub 3 m; fruiting
 calyces sticky; fruit edible. Sinclair, I & Long, D 5006. 14
 Sep 1984.

- 19841879 *Podophyllum hexandrum* Royle 1 Jul 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: East bank of Tharizam Chu. 4300
 m. 28°1'N, 89°35'E. Amongst boulders & shrubs in dry stream
 bed. Erect herb 70 cm; fruit red. Sinclair, I.W.J. & Long,
 D.G. 5308. 24 Sep 1984.
- 19841828 *Hordeum vulgare* L. 12 Nov 1995
 Our source: 630 (= Sinclair & Long)
 from a cultivated plant not of known wild origin
 Bhutan: Upper Mo Chu Dist.: Laya. 3840 m. On grassy bank
 amongst cultivation. The cultivated barley. Sinclair, I &
 Long, D 5125.
- 19841852 *Meconopsis paniculata* (D.Don) Prain 12 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: Hillside above Laya. 4230 m.
 Amongst block scree with scattered shrubs. Sinclair, I &
 Long, D 5198.
- 19841815 *Gentiana tibetica* King ex Hook.f. 12 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Upper Mo Chu Dist.: Near Kohina. 3230 m. 28°N,
 89°47'E. Damp streamside in *Abies/Larix* forest. Herb in
 fruit. Sinclair, I & Long, D 5074. 17 Sep 1984.
- 19841744 *Angelica sikkimensis* C.B.Clarke 8 Nov 1984
 Our source: 630 (= Sinclair & Long)
 collected directly from wild; origin known
 Bhutan: Thimphu Dist.: Dechhenphu, N. of Thimphu. 2480 m. In
 cleared *Pinus wallichiana* forest amongst *Artemesia*.
 Sinclair, I & Long, D 4820.

Appendix 3

Label printer

Dymo LabelWriter 310



The most versatile label printer for any office. Handles more than 40 standard label sizes up to 59 mm wide, including address, shipping, file folder, disk, video, name badge, cassette, ZIP disk, and many more. Comes with easy to use Dymo Label Software, integrates directly with Microsoft Word, Outlook, the Palm Desktop and works with all other software through standard print drivers.

Eliminates the hassle of printing labels with a desktop or network printer.

Direct thermal print technology eliminates ribbons, toner and ink cartridges.

300dpi resolution for laser sharp labels - double the resolution of any other label printer brand.

Prints labels up to 59 mm wide.

Prints labels in under 4 seconds, 16 per minute.

Connects to USB for easy installation. PC or Mac.

Automatically captures addresses from popular applications for instant address labels with no retyping.

Easy to share over a network.

Prints Code 39, Code 128, Codabar, UPC A/E, EAN 8/13, EAN 128, ITF-14 and Interleaved 2 of 5 bar codes.

Internal, auto-switching power supply works worldwide.

Works with Windows 98, 2000, Me and XP. Also Macintosh OS 8.6, 9, 9.1, 10.2.4 and 10.3.

Further details at:

<http://www.dymo.com>

Price: £115

APPENDIX 3

Mist Unit parts list

Name	Part No.	Product Info	Quantity
Control Unit	25-09-021	240v	
Electronic Leaf	25-09-003	25m	
Brass Mist Jets	30-02-001	Size 1	
Elbows 90°	21-26-081	½" x ½"	
Threaded Trees	21-24-161	½"	
Sediment Strainer	22-29-001	½" BSP F	
Stopcock	21-28-001	½"	
Solenoid Valve	25-10-030	½" BSP F.F 24v	
PVC Pipe	23-43-602	½" 1m	
PVC Pipe	23-43-601	½" 1/2m	
PTFE Tape	21-30-051	Thin	
Hexagon Nipple	21-38-012	½" x ½"	
PVC Plug	21-35-002	½"	

Appendix 4

Medicinal Garden

The Medicinal garden is a collection of plants used in traditional medicine in Bhutan. It has the potential to be a valuable teaching and conservation rescues.

Medicinal Garden Plant List

Grid Number/Plan Number	Tentative Name	Comments
01	<i>Picea</i>	Alternating in a repeat pattern as an informal hedge?
02	<i>Larix</i>	
03	<i>Cupressus</i>	
04	<i>Abies</i>	
05		Dead plant
06	<i>Compositae?</i>	
07	<i>Salvia?</i>	Labeateae?
08	<i>Fraxinus</i>	
09	<i>Quercus</i>	
10	<i>Elaeagnus</i>	
11	<i>Berberis</i>	
12	<i>Chaenomeles laevigata</i>	On label Choenomeles
13	<i>Ginkgo biloba</i>	
14	<i>Punica</i>	Pomegranate
15	<i>Taxus</i>	
16	<i>Meconopsis napaulensis</i>	Monocarpic propagate by seed
17	<i>Scopolia?</i>	Solanaceae
18	<i>Cupressus</i>	
19	<i>Salix</i>	
20	<i>Potentilla</i>	Herbaceous
21	<i>Taxus baccata</i>	
22	<i>Potentilla</i>	In triangular hedge
23	<i>Juniperus</i>	
24	<i>Chaenomeles laevigata</i>	As 12
25	<i>Chaenomeles laevigata</i>	
26	<i>Chaenomeles laevigata</i>	
27	<i>Astilbe</i>	Weed?
28	<i>Rosa sericea</i>	
29	<i>Betula</i>	
30	<i>Colocasia esculenta</i>	Taro
31	<i>Hedichium</i>	Ginger
32	<i>Astilbe</i>	Weed?
33	<i>Ginkgo biloba</i>	
34	<i>Rubus</i>	Orange fruit, seeds sown
35	<i>Taxus</i>	
36	<i>Cupressus cashmeriana</i>	
37	<i>Mentha</i>	Species one

38	<i>Allium</i>	
39	<i>Mentha</i>	Species two
40	<i>Ginkgo biloba</i>	
41	<i>Ginkgo biloba</i>	
42	<i>Jugulans regia</i>	
43	<i>Berberis aristata</i>	Labelled, seeds sown
44	<i>Hedichium</i>	As 31? Two smaller clumps
45	<i>Hedichium</i>	
46	<i>Myricarpa rosea</i>	
47	<i>Myricarpa rosea</i>	
48	<i>Myricarpa rosea</i>	
49	<i>Berberis</i>	
50	<i>Hippophae salicifolia</i>	
51	<i>Hippophae salicifolia</i>	
52	<i>Myricarpa rosea</i>	

Objectives

The objective of this work is to try to make this area more cohesive; more accessible and educational to the visitor: make more of a feature of the plants and lastly to reduce maintenance.

Recommendations (see plans)

Grid Number/Plan Number	Comments
1 - 4	Thicken planting with shrubs of medicinal value. Under plant with ground cover of medicinal value. These are all potentially large trees which will out grow the site and over grow the path. In five years consider selective thinning.
31,44,45	Lift and divide <i>Hedichium</i> to form one large clump.
32, 27	Lift and divide <i>Astilbe</i> to form a clump.
13,33,40,41	While dormant move the Ginkgo together to form a grove.
37,38,39	Lift and divide <i>Allium</i> and <i>Mentha</i> to form large blocks along the side of the path. Raising the soil level to the path height.
46.47,48	Move into a tighter group.
22	This is an informal area, lift and plant in an irregular shape , above the <i>Hedichiums</i> .
6,7	Extend and amalgamate these, particularly on the top side to the hedge
8,9	Form a bed
16,17,18,20,21	Form into a bed, lift and divide the <i>Potentilla</i> for the sunny side and use seed raised <i>Meconopsis</i> on the shady side. N.B. Collect seed of the <i>Meconopsis</i> every year as it is monocarpic.
34	Move to area A and add seed raised plants.
A	Thicken up this area with other shrubs of medicinal value. This will define the area and give it a backdrop camouflaging the power pylon, when viewed from the main path.
B	Add a group of shrubs in this area to balance existing groups of shrubs.
C	Collect seed in the wild of medicinal grassland herbs plant at 15 cm

	spacings in this area. Cut the grass after the have seeded to allow the medicinal herbs to perpetuate and spread.
D	Make a bed to grow <i>Podophyllum</i> .
E	Wigwam of posts to grow annual Cucurbiaceae.
F	Close mown path allows access through the area
G	Interpretation board.

It is recommended that contact is made with the hospital using traditional medicine in Thimphu for recommendations on species that should be grown. For the interpretation find out what the plants are used and what they are used to treat. In consultation with the herbarium a prioritised list should be made, ranking those plants most threatened highest. This list can then be used to further enrich the species content of the area. Every effort should be made to propagate plants by seed or by vegetative means rather than removing plants form the wild.



The Medicinal Garden, July 2004.

Program of achievement and maintenance.

Re-soil the area at the side of the path. Raise the level to the height of the treads.

The shrubs and trees in this area are growing well, this scheme requires the movement of the minimum number of shrubs and trees. The movements should be done in the dormant season as indicted above.

Propagate as many of the shrubs a possible to create larger groups, try softwood cuttings in the spring and hardwoods in the winter. Many are also producing viable seed which can be collected and sown when ripe.

Lift and divide the herbaceous plants before the start of the wet season. Prepare the beds as indicated on the plan and above. Dig them over and incorporate compost.

In late summer and autumn, collect seed from the wild of grassland medicinal herbs sow and grow on for planting before the wet season starts, in area D. The grass in this area should be cut only when these plants have seeded.

Propagate new shrubs and trees with medicinal value from the target list to thicken the planting in area A.

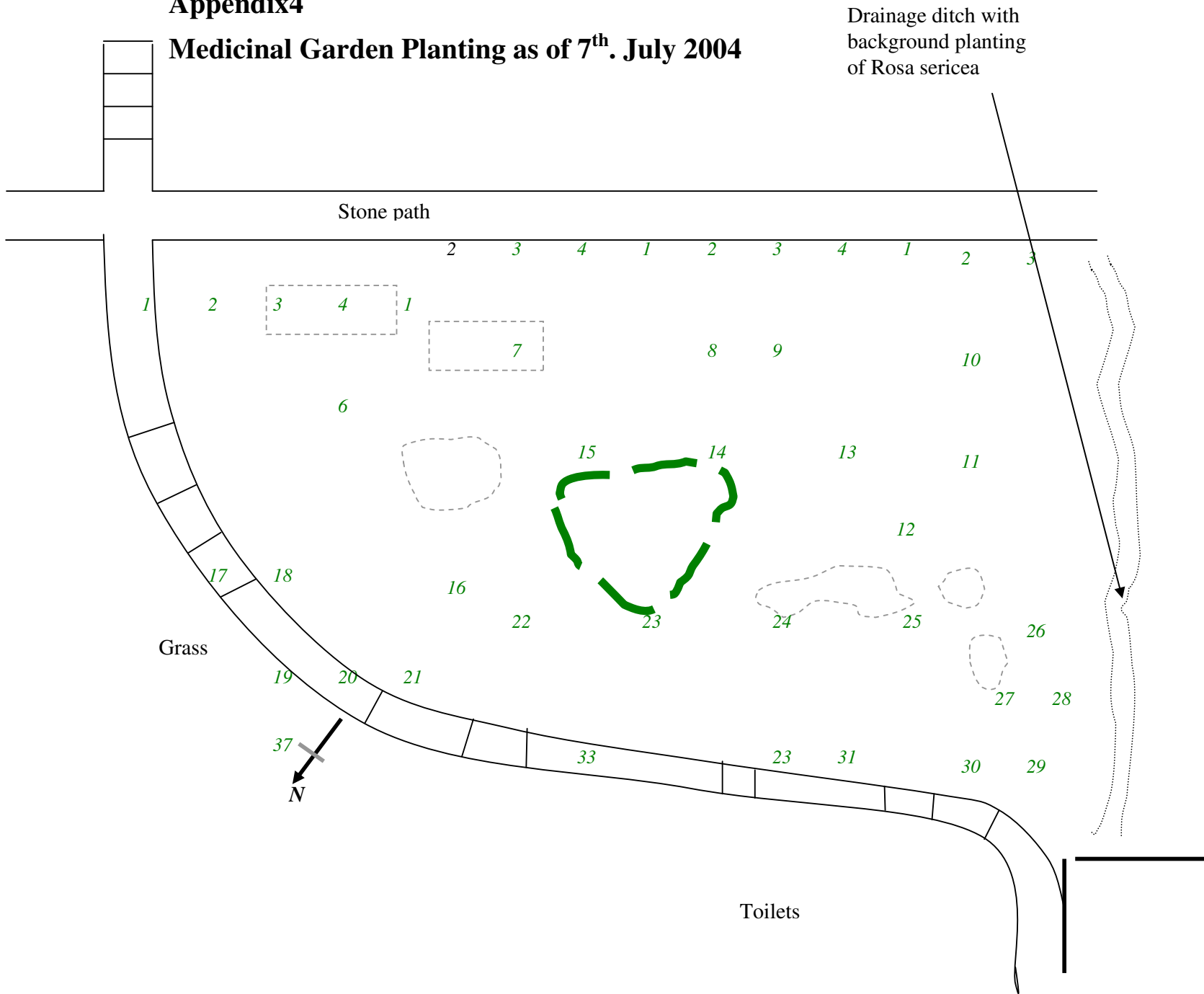
Mow the grass path through the area as needed in the growing season.

Collect seed of short lived plants and annuals.

Have a dedicated member of staff with an interest in medicinal to look after the area.

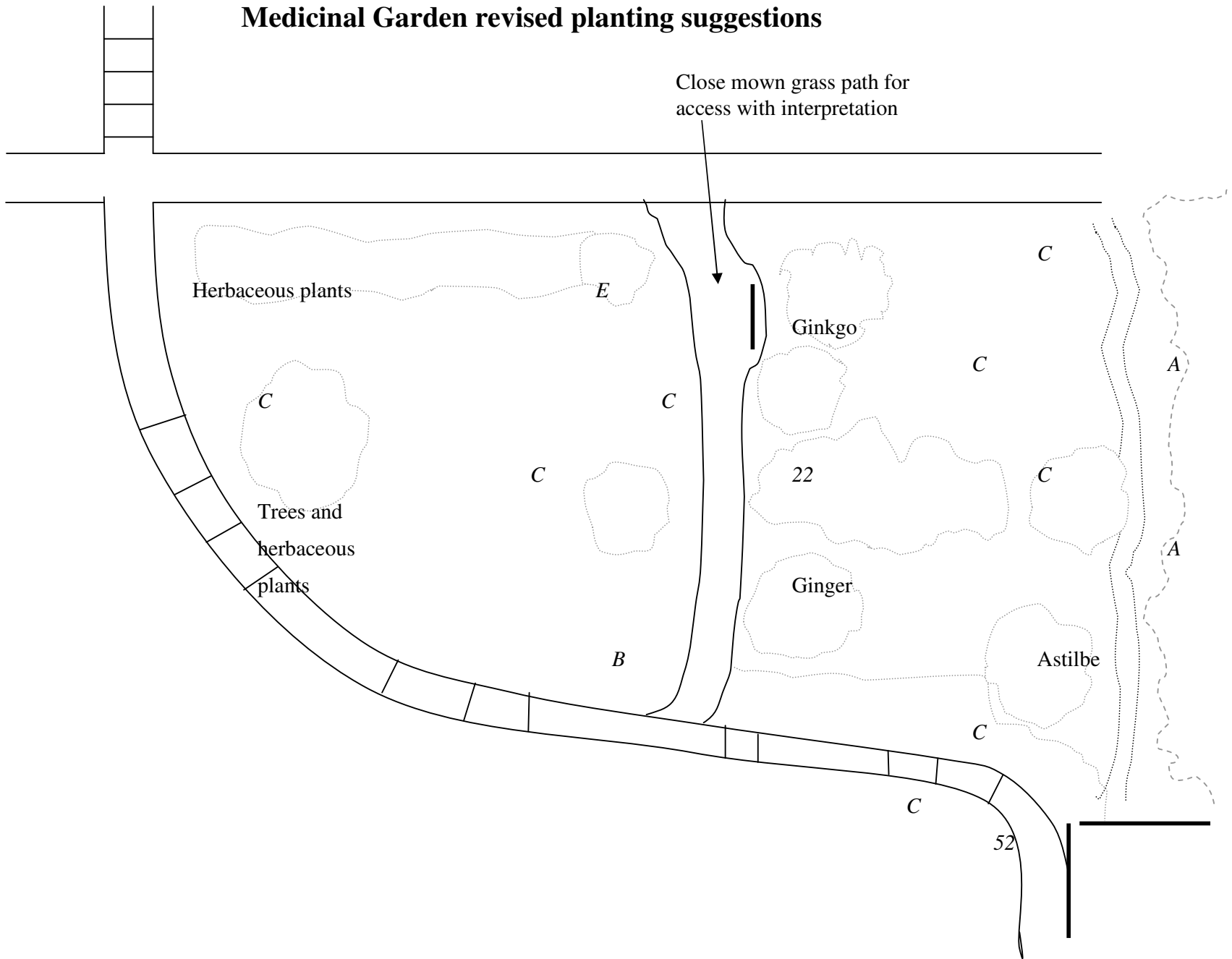
Appendix 4

Medicinal Garden Planting as of 7th. July 2004



Appendix 4

Medicinal Garden revised planting suggestions



Appendix 5

The Rose Garden and surrounding Fruit Garden

The Rose Garden comprises a series of formal beds surrounded by an informal hedge, it has strong amenity value for the casual visitor. Surrounding the area is a Fruit Garden which could have a strong conservation and educational role in the preservation of traditional varieties of fruit, in particular apple.



The Rose Garden,
July 2004

Recommendations

Rose Garden

Build a seat around the *Daphne bluha* in the centre of the rose beds to allow visitors to enjoy the colours and perfumes of the roses and the Daphne.

Move the ground cover roses into one bed, plant through landscape fabric (sample supplied) covered with bark. This will make them easier to maintain as the weeds will not grow through the plants.

Prune the hybrid T s to an outward facing bud in the winter before grow commences and mulch with compost.

Choose one or two varieties that are growing the strongest on the site and replace the ones which are not growing well. (Probably best to buy in plants but the staff should try budding.)

Use planting membrane in this area covered with sterile compost into which Marigolds (*Calendula* cv.) and Forget-me-not (*Myosotis* cv) can be sown. These plants may deter the insect attacks which are at present decimating both the foliage and the flowers.

Close mow the grass paths on a weekly basis.

Remove the black cable or pipe which is running across the area.

Improve labelling and interpretation.

Fruit Garden

Represent all of the historic cultivars of apple in Bhutan in this area.

Represent other edible plants *Rosa*, *Elaeagnus*.

Represent the wild species of cultivated plants, *Malus*, *Prunus*.

Provide mown paths through the area to improve access.

Improve labelling and interpretation.

Define the area with in informal hedge of an edible species, *Cydonia*, *Rubus*.

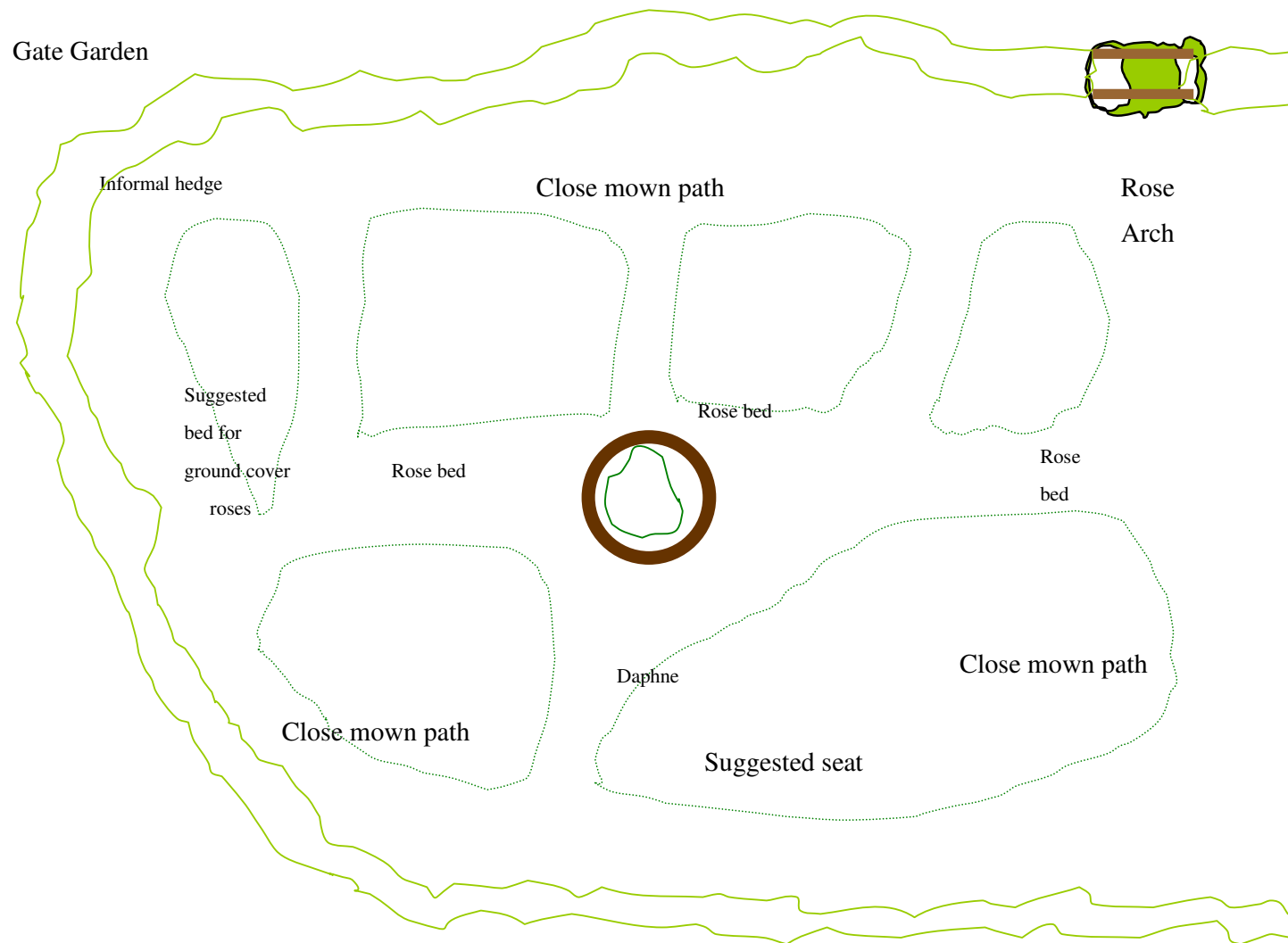


The Fruit Garden,
Jul 2004.

Appendix 5

The Rose Garden and Surrounding Fruit Garden

Scale 1:1000



Appendix 6

General recommendations

(Numbers in brackets refer to plan in this appendix)

The green house (1)

For the plants in the pots on the rafters, provide a pulley system to raise and lower them so that they can be easily maintained. Provide stiff crook shaped watering lance long enough to reach these plants.

Avoid hanging plants which need a lot of water above plants which prefer to be dry for all or part of the season.

A dedicated member of staff is needed to maintain this area. Who can gain the knowledge through experience of the plants, watering, humidification, heating ventilation and shading of the greenhouse.



Climbers will provide shade.

Pest and disease identification and treatment is of the utmost importance to prevent rapid spread of pests such as mealy bug, red spider, and aphids. It may be a good idea to quarantine plants in pots in a small house and only add them when they are 'clean'.

Mulch the soil with compost to improve it and help to retain moisture. (Except Cacti area).

Grow more climbers over the roof trusses to provide natural shade. Deciduous climbers are very useful for this as they allow more light into the plants below in the winter.

Allow the larger trees to grow to develop shade and humidity before introducing a ground flora which is easily scorched or dehydrated by strong sun and lack of humidity.

Some of the newly introduced orchids require moss on their supports to allow them to establish. Accurate records need to be kept of the plants introduced from the wild.

Some of the trees may grow too large for the greenhouse; they should be pruned when they have grown to within 50 cm of the roof.

A list of the species which are to be introduced should be created, this could have themes for the various beds, tropical economic crops (the rice cultivar most commonly grown, sugar cane, tea, coffee); CITES listed plants (*Ceropegia* from the Indian border area).

Heavy white wash shading has been applied, test now for a suitable method of removal. Both the Greenhouse and the Orchidarium need signage to encourage visitors to enter them visitors seem reticent to enter them.

Interpretation and labelling in this area is very important.

A strategy for the maintenance of the structure should be developed. (Broken window replacement, wood treatment, life span on the corrugated plastic roof in a high UV area.)

Pond and map of Bhutan (2)

The stream through the Prayer Wheel needs a more reliable supply of water.

Improve the soil by the stream with compost plant moisture loving species found by streams in the wild, *Astilbe*, *Primula*, *Iris*.



Pond would benefit from marginal planting and aquatic plants.

Create a small bog in the pond to grow Carnivorous plants, *Drosera*, *Pinguicula*, *Utricularia*.

Try to grow *Nelumbo neucifera* in the pond. In winter drop the pots to 30 cm below the waters surface they should then be hardy to -10 °C (3).

It may be possible to grow other tropical water lilies, day blooming are more interesting to the visitor than night blooming.

Introduce other floating and oxygenating plants, these are all likely to be low land species as in the mountains the rivers are too fast flowing.

Monitor the fish population as they have started to breed and the pollution level from their waste will quickly increase with poor flow and no plants to absorb nutrients. (Avoid them being introduced to wild.)

Ensure that the channel surrounding the map of Bhutan is kept full of water. (Introduce fish to keep mosquito populations to a minimum).



Mark out the provinces of Bhutan in different coloured bedding plants.

Plant the map in bedding plants defining the regions/provinces of Bhutan. Grow an evergreen plant in the positions of Thimphu and other major towns/administrative centres. Represent the snow covered areas with white flowers(4).

General recommendations for other areas of the garden

Companion plant with plants that deter insect attack.

Investigate an irrigation system that delivers water to the root of the plants rather than into the air and water logging. (Reduced water use, evaporation and reduced growth of the grass.)



Flooded tree pits can lead to root rot in young transplants.

Prioritising of some areas in the garden would help to maximise the visual impact of the garden, and help with the maximise the limited recourses of the garden. Some areas could be left wild e.g. stop work on the arboretum, giving the trees already planted time to get established, also in a few years time this will allow a second round of planting with under story plants. The Arboretum need only be strimmed once a year at the end of the growing season (5).

The front entrance is one area of the garden that would benefit a lot from extra planting to increase, first impression impact. The car park is a large area that could have a section screened off for storage of materials, which are presently scattered in piles around the car park. There is a small stream flowing around the car park that could be tidied up, this would be an ideal area for growing *Primulas Astilbe Iris* and *Meconopsis* (6).



The polluted stream could play host to moisture loving plants which would thrive on the nutrients. The steep banks could be clothed with *Cotoneaster* and *Elaeagnus*.

The small wall that runs between the rock garden and rose garden could be finished off with copping stones, and the hedge at the side of this trimmed to look a lot neater than at present. The shrubs used do not lend themselves to a formal hedge, they may better suit an informal hedge with minimal clipping (7).

The paths in the garden have a weed problem but when they are weed free they are very attractive paths but perhaps it might be worth looking into making gravel paths laid on landscape fabric, in the garden as this would minimise the weeds and hopefully be easier to maintain and cheaper (8).



The new paths require strong cement joints to prevent weed growth. When they are constructed they should be sunk deeper into the ground to prevent visitors falling off the sides of the path. Risers should be a maximum of 15 cm. (more of a human scale). Gravel paths may be a suitable

At the present the visitors to the garden often enter via the staff entrance, this does not create a good impression and is also not a particularly attractive area in comparison with the main garden entrance. A lot of the visitors only seem to go as far as the lawn area then stop not seeing the rest of the garden, making people come in via the main entrance means they would have to walk through the main part of the garden before they reached the lawn, time to sell the 'message' of the garden(9).

Equisetum (Horse tail), this weed is very difficult to control. Crush the foliage and treat with a systemic herbicide; it will need more than one treatment. Where it is known to grow use a double thickness of landscape fabric covered in a decorative mulch.(10)



Equisetum in the Rock Garden

A sign on the main road showing the turn for the garden would help to alert potential visitors. Perhaps the gardens also suffer from a lack of realisation that it is Bhutan's Royal Botanic Garden, the public see it more as a park. Small things like signs and pamphlets all help.

One of the strengths R.B.G.E is the specialisation of the staff. The Orchid House at R.B.G.S has a specialist worker and this is reflected in the high quality of this area, but the glasshouse for example seems to be getting watered by several different people, and some areas within it are being watered incorrectly, this is leading to some plants suffering from either over or under watering. Also letting staff specialise helps them feel more accomplishment within their job.

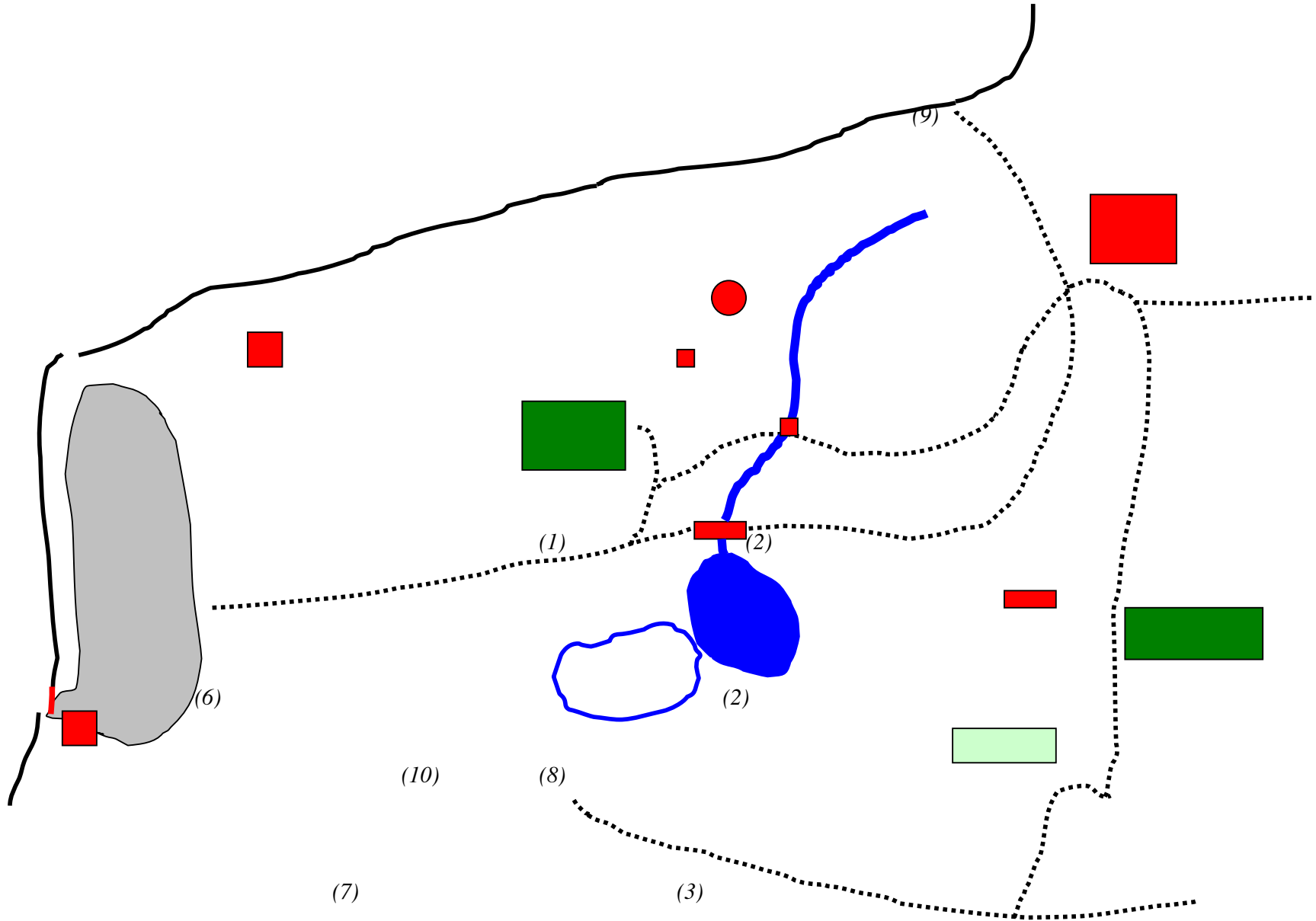
Nursery work can also be specialised, and it is recommended that an interested member of staff be found to look after this area, with a new area like this it would mean that some of this person's knowledge would develop as the nursery develops.



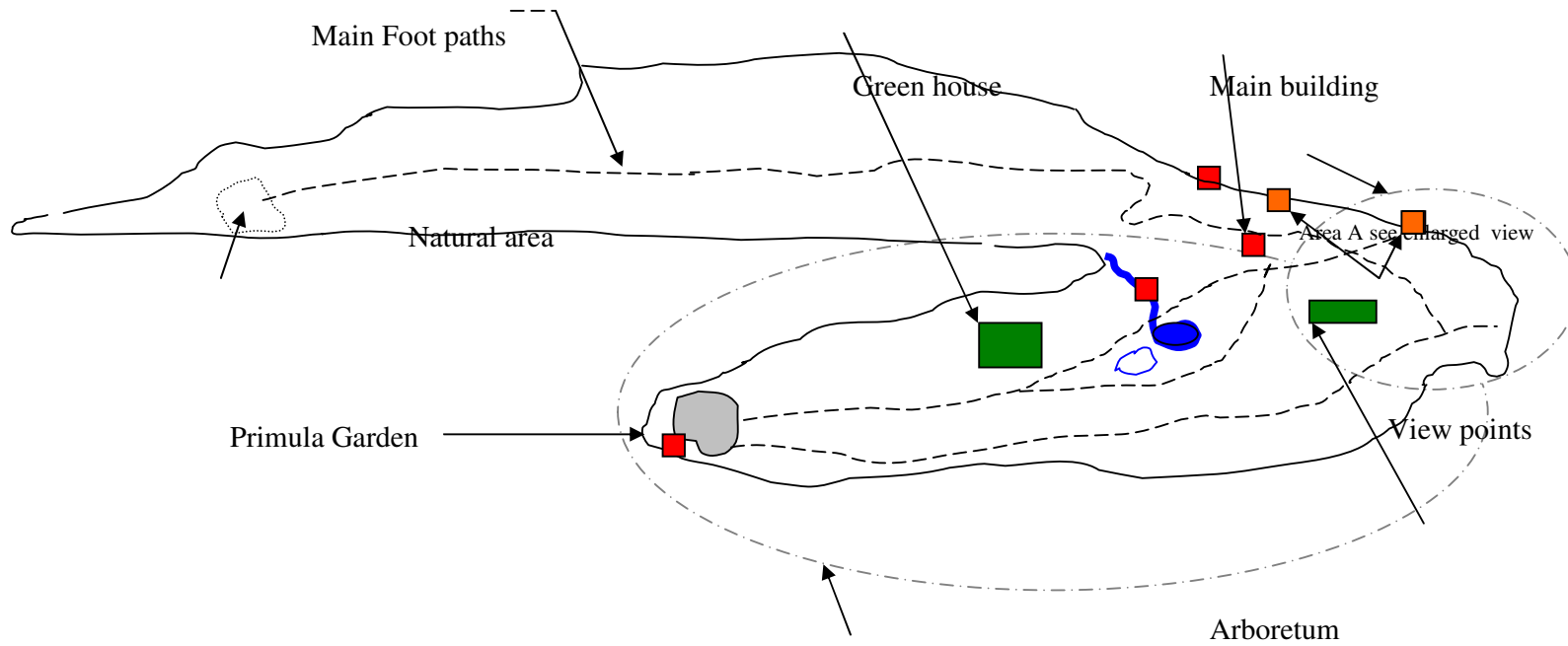
Nursery work is specialised and requires dedicated staff. By their nature there are expensive in equipment, materials and labour!

Appendix 6

Areas mentioned in text.



Appendix 6
Map of the
Royal Botanic Garden National Biodiversity Centre, Serbithang, Bhutan.
General view

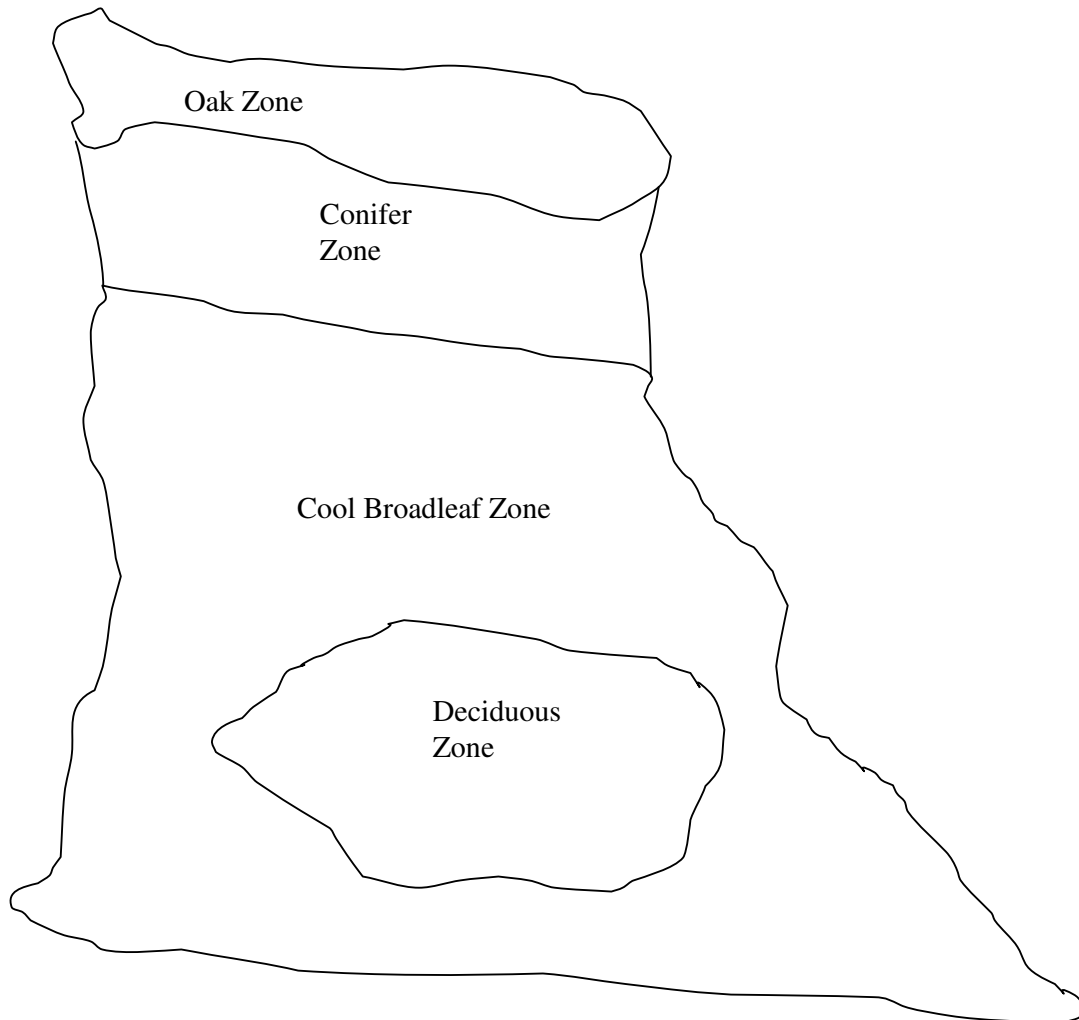


Appendix 6

Area A

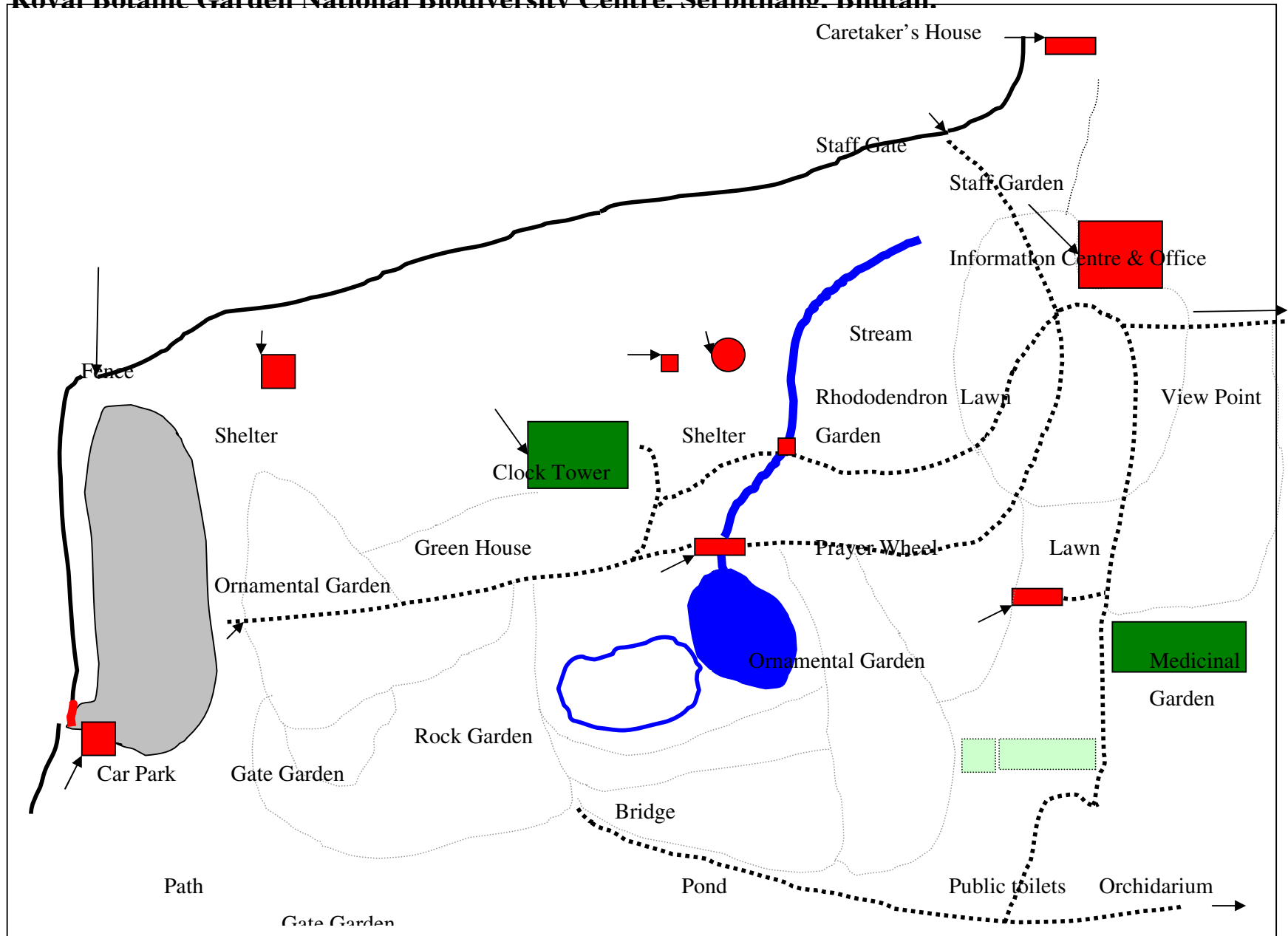
**Royal Botanic Garden National Biodiversity Centre, Serbithang,
Bhutan.**

Arboretum Zones



Appendix 6 Area B

Royal Botanic Garden National Biodiversity Centre, Serbithang, Bhutan.



APPENDIX V

***Darwin Initiative –
Royal Botanic Garden Serbithang Project,
Bhutan***

***Education Report
July 2004***

***Staphanie Walker, Cath Evans and Ian Edwards
Royal Botanic Garden Edinburgh***

The Aims of the Visit

The following report follows a visit made to Bhutan under the auspices of the Darwin Initiative by Education Officers Cath Evans and Stephanie Walker and Director of Public Programmes, Dr Ian Edwards, from 8 – 28 July 2004. The principle aims of the visit by Education Officers from the Royal Botanic Garden Edinburgh (RBGE) was to support the development of education and interpretation at the Royal Botanic Garden Serbithang (RBGS) through:

- exploring the opportunities for education within the Botanic Garden for schools and the wider community

- obtaining a general overview of environmental education initiatives within Bhutan through meetings with the

Education Department Curriculum and Communications Officers and environmental education practitioners from local Government and non-governmental organizations, such as the Royal Society for Protection of Nature (RSPN) and the Nature Conservation Department

- deliver an environmental education workshop for school teachers, to also include staff from NGOs/environmental agencies

- deliver education workshops for school children

- explore possible links with other governmental and non-governmental environmental education providers

Overview of Environmental Education in Bhutan

Meeting with the providers of environmental education in Bhutan proved to be extremely useful in providing an overview of environmental education framework within Bhutan and future proposed projects. Through discussions with organisations there is clear support for the RBGS and the role it can play in contributing in a unique and innovative way to the environmental education provision in Bhutan. Meetings were held with the following organisations: Nature Conservation Division (NCD), National Environment Commission (NEC), CAPSD Department of Education; Royal Society for Protection of Nature (RSPN). A report of the meetings is provided in Appendix 1. There are shorter summaries of the main points of interest below.

Education Department: *Environmental education is delivered within the schools curriculum. Curriculum and Communication Officers of the National Education Department provide training workshops and environmental education teaching materials for teachers. Within the education framework in Bhutan teachers will attend 4 CPD workshops a year, one of which will be in environmental education. The Education Department has also had a very successful project in greening school grounds, with 30 Schools taking part.*

RSPN: *To support environmental education within the education framework, the RSPN provides training, education materials and support for teachers to deliver Nature Clubs as an after school activity. The RSPN have been very successful in raising awareness of environmental issues through projects such as the adoption of a stream in a school district.*

Department of Conservation: *NCD has responsibility for planning, management and environmental education in protected areas and reserves. These areas contain communities and they have an integrated programme to prevent conflict between people and wildlife conservation. The target audiences include farmers, schools and teachers, religious communities and itinerant road workers. Issues include the collection of non-timber forest products such as mushrooms, bamboo, medicinal plants and firewood, as well as grazing and shifting-cultivation. The Bhutanese have a strong conservation ethic and visits to national parks are popular with teachers and students. NCD run workshops for staff and teachers and produces resources including videos, brochures, fact sheets and maintains a website.*

National Environment Commission: *NEC has a role in coordinating environmental education in the country. A draft EE strategy was produced 2- 3 years ago and awaits approval by the Ministry. Schools have been provided with equipment to monitor water quality in local streams as part of year 8/9 science projects. This information is used for determining trends in water quality. The Wang watershed project (with RSPN) was regarded as a model project in action based learning.*

Current Provision of Environmental Education at the Royal Botanic Garden Serbithang

The staff at the RBGS were keen to share their experiences of education in the Garden and their ideas/suggestions for the future. Education plays an integral role within the long-term strategy for the RBGS. The Director of the National Biodiversity Centre (NBC), which includes the RBG, Dr Ugyen Tshewang, is committed and enthusiastic towards developing education initiatives within the RBG to raising awareness of environmental issues within Bhutan. As part of the NBC the RBG will provide a platform for promoting the work of biodiversity conservation at both national and international level, including providing a window on the work of the National Herbarium and newly created Gene Bank.

At present there is no formal structure for education at the Garden or staff member designated solely to delivering and developing education activities/events with the RBGS. On request, staff will give a general tour of the Garden to visiting groups. There are plans in the next 5 year plan (2007 – 2012) to appoint an Interpretation Officer with education as part of the post remit (see the Interpretation Master Plan for more details).

Potential for Development of Education at the Royal Botanic Garden Serbithang

The RBGS has a unique and well-situated resource which could be utilized by schools surrounding Thimpu and beyond for environmental education on the underlying theme of biodiversity. The Garden contains a good selection of plants from throughout the country with a particularly good collection of orchids and a growing collection of native trees and shrubs. The Garden is surrounded by green areas, offers excellent views of the Paro valley and attracts a variety of wildlife, especially birds and insects.

Education topics need to be curriculum-linked and to provide a real opportunity for the enrichment of current classroom teaching. These need to be planned in conjunction with the Education Department and teachers and NGOs already working in this area.

- *Education topics should also reflect the themes set out in the Interpretation Master Plan. Particularly relevant themes include: Plants and People; Plant inter-relationships; Growing plants; and Biodiversity Conservation.*
- *Topics should be chosen at the appropriate level for the pupils.*

Although schools are an important audience for educational activities at the Garden Serbithang gets many other visitors and educational groups. Other targets for education are:

- *Agricultural and forestry groups*
- *College students*
- *Community groups/leaders*
- *International conference delegates*
- *Tourists (both national and international)*

These special interest and general audiences are dealt with in more detail in the Interpretation Master Plan.

Teacher and Student Environmental Education Workshops delivered at the RBGS

Several workshops were arranged to share information and environmental education activities with teachers, environmental education providers and children.

1. Nature Club - Monday 19th July

20 students and 3 teachers from a nature club in Phobjikha a village located in the west central region of Bhutan. The group visited the RBGS as part of an end of school year trip. The visit to the RBGS in the morning was complemented by a visit in the afternoon to the RSPN. Due to the distance traveled the group stayed overnight at accommodation available at the NBC. The DI team did not receive prior warning of the visit, however, this chance event provided them with an excellent opportunity to deliver a series of impromptu environmental education activities. The nature club and the staff in the RBGS took part in an enjoyable two hours of environmental games and an art activity. It provided valuable experience in working with Bhutanese children, sharing ideas and experience of the natural environment in Bhutan.

2. Teachers Workshop - Friday 23^d July

A full day workshop was delivered to 30 teachers and representatives of environmental organizations. The programme development and delivery was carried out in collaboration with the staff of the RBG who contributed their ideas and specialist areas of interest. Prior to the workshop RBG staff were provided with an opportunity to try out activities to build their confidence so that they would have a 'hands-on' approach to the actual workshop delivery. A set of notes were given to each participant detailing the day's activities and follow-up ideas. RBGS staff led a tour around the Garden explaining about the different plants and aspects of horticulture in each area and answering many questions. After lunch the group was divided into two for an art activity and one involving practical horticulture.

3. Student Workshop - Monday 26th July

A full day workshop was delivered to 30 students from schools around Thimpu and beyond. They were aged between 10-17 years and attended voluntarily as the schools were on holiday. A similar programme was followed to the workshop for teachers with the addition of various environmental games to teach about habitats and animal and plant relationships in a fun, informal way.

The day was rounded off with a video produced by Kew Gardens on plants around the world and environmental issues.

Suggestions for Education Activities/Events in the Future

The provision of environmental education at the RBGS will grow and develop as the Garden itself continues to grow and develop, offering ever more opportunities.

Discussion with the staff of the RBGS and others led to the following ideas for expanding

provision in the future. Further work on all these areas might be possible during the next part of the DI programme.

1. The Interpretation Centre provides a very valuable resource for holding events such as schools and teacher workshops. However the displays could develop a more educational focus. This could be achieved through display interpretative panels, objects (nature table), art exhibitions and an audio visual presentation.

2. Work in collaboration with other environmental education providers to develop education activities and use the unique facilities of the Garden to promote joint initiatives, including environmental education workshops, with organizations with similar aims and objectives. Some of these bodies already have education officers who would be willing to run workshops at the Garden in conjunction with RBGS and NBC.

3. Hold a series of public events or Garden Open days throughout the year. Each Open Day would have a theme and would be co-coordinated by the RBGS Interpretation Officer. This offers further opportunities for collaboration with NGO and government partners in Bhutan. There is a demand for practical ideas, for example from the large number of school greening projects, that could be met effectively by these events. Some suggestions are:

- Creating a rock garden*
- Planting in containers*
- Orchids*
- Plant propagation*
- International biodiversity Day, 22nd May*
- Social Forestry Day*

4. Further development school workshops that link directly to the curriculum in collaboration with the Education Department. These would be supported by simple information sheets on plants for teachers.

Suggestions of schools activities include:

- Green Kingdom – plants and their needs*
- Art and craft activities*
- Spearhead an environmental awareness campaign on recycling and litter e.g. 'Keep Bhutan Clean'*
- Gardening club for children*

5. General visitors (family groups, etc.) will be provided for through the development of interpretation at the Garden (see the Interpretation Master Plan). Ideas that will help education the general visitor on the purpose and work of the Garden include simple activity sheet for family groups that could tie in with the RBGS map

Appendix - Report of meetings held in Bhutan between RBGE/RBGS Education team and Bhutanese environmental education specialists

1. Royal Society for the Protection of Nature, Thimphu

Mr Mincha Wangdi (Environmental Education Coordinator), Mrs Rebecca Pradham (Ecologist)

The RSPN is an NGO active in the area of environmental education in Bhutan especially through its support of nature clubs in schools. It provides materials, financial support and training for teachers but the success of nature clubs ultimately depends on strong support from the principal and teachers. There are 80 affiliated nature clubs across the country. Activities include visits to national parks. There are also up to 90 minutes of school-based activities per week. These are easier to achieve when the students are boarders.

The formal education curriculum was established in 1986 based on traditional subjects such as history, geography, science, etc. There has been an evolution in the development of formal education with a gradual move to become less exam and more process orientated and to include areas such as health and environmental issues into the curriculum.

The Wangi Watershed Project involves 12 schools in monitoring water quality (see also NEC below). Schools are provided with equipment, resources and training so they can monitor human activities, wildlife, water quality and aquatic insects. The learning programme extends beyond science to cover geography, language and other areas of the curriculum.

Schools frequently organised visits to areas of nature conservation interest although some teacher opted to teach field work in the classroom to save time. The Education department has produced a guide to outdoor education. There is also a joint NCD publication on environmental games and activities. Conservation-related activities are often linked to events such as Social Forestry Day, Biodiversity Day and World Environment Day.

In the past RSPN were able to support nature clubs through a grant from WWF. But this will not be available in future as WWF have decided to prioritise other areas. RSPN are currently seeking another donor organisation.

2. Nature Conservation Division, Thimphu

Mrs Sonam Chocken, Environmental Education Officer

Mrs Sonam explained that there are 9 protected areas in Bhutan and 6 of these are operational. The first national park in Bhutan was declared in 1993. NCD has responsibility for planning, management and environmental education in these areas. Her team consists of five people. The protected areas contain communities and they have an integrated programme to prevent conflict between people and wildlife conservation. The target audiences within protected areas include farmers, schools and teachers, religious communities and itinerant road workers. Issues include the collection of non-timber forest products such as mushrooms, bamboo, medicinal plants and firewood, as well as grazing and shifting-cultivation.

The Buddhist Bhutanese have a strong conservation ethic and visits to national parks are popular with teachers and students. NCD run workshops for staff and teachers on environmental education. NCD has also produced six 15 minute videos on the parks with BBS and their communications department has produced brochures, fact sheets and maintains a website.

There is good collaboration between NCD, RSPN, NEC and WWF.

3. National Environment Commission, Thimphu

Mr Tandin, Communications and Outreach Unit

The NEC is the Government body responsible for the environment in Bhutan. I has a role in coordinating environmental education in the country. A draft EE strategy was produced 2- 3 years ago and awaits approval by the Ministry. NEC only has two people responsible for communications and outreach and when they have access to donor funds they are able to pass this on the NGOs like RSPN who are involved in frontline work in schools.

Deforestation is not a major problem at present but air quality and water quality are becoming environmental issues in Bhutan. Schools have been provided with equipment to monitor water quality in local streams as part of year 8/9 science projects. This information is used for determining trends in water quality. The Wang watershed project (with RSPN) was regarded as a model project in action based learning. There is also a video produced to communicate environmental issues in Bhutan. Mr Tandin, who is trained in media communications, felt this was very valuable as most documentaries produced by outside film-makers idealise the country and its wildlife.

Mr Tandin knew RBGS and felt it offered potential for informal learning. He said biodiversity is part of the teaching in schools at year 11/12. Although he supported the idea of a workshop he mentioned teachers do get invited to a lot of different workshops to launch new projects and warned of workshop fatigue!

4. Department of Education, CAPSSO, Paro

Mr Wangpo Tenzin, Curriculum Officer (Science and Environmental Education)

Mr Wangpo explained the delivery of science and environmental education through the Bhutanese school curriculum. Up to level 8 students are taught a general science course. After that there is a division into the traditional subjects of Physics, Chemistry and Biology. At the highest level there is a distinction between botany and zoology. Ecosystems and the classification of animals and plants are included in the curriculum and an element of field work is expected. Topics taught include: ecosystems, environmental chemistry, food chains, agriculture, forestry, medicinal plants, endangered and rare species. The education Department is keen to promote best practice among teachers and in particular there is a current emphasis on 'education through involvement'. Teachers are given opportunities to take part in in-service development programmes organised by the Education Department and others, including RSPN. Subjects for in-service development have included practical agriculture and health. They usually take place during the winter break from December to mid January.

The Education Department encourages fieldwork and this can include visits to national parks and nature reserves. Schools have tents and are prepared to take students on overnight trips. This often includes an element of wildlife watching and trekking. It also can include standard ecological field work practices such as quadrat sampling and studying different adaptations.

Mr Wangpo also gave us further insights into the Green programme for school grounds and suggested a role for the RBGS in providing practical advice and demonstrations for teachers and others involved in establishing school ground nature areas. Unfortunately the funding for this excellent programme is coming to an end but it is hoped that another external donor can be found to support the work in the future.

APPENDIX VI

Darwin Initiative

Royal Botanic Garden Serbithang, Bhutan

In collaboration with

Royal Botanic Garden Edinburgh, Scotland, UK

Interpretation Master Plan

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<i>Appendix 3</i>	<i>Sample interpretation panel - design</i>

Why Interpret?

Although it was only established in May 1999, the Royal Botanic Garden Serbithang (RBGS) is already attracting a large number of visitors of all ages and levels of interest. Visitor numbers will increase as the Garden develops and people appreciate the value of green space on the edge of the expanding Thimphu urban area. People visit mainly for leisure and recreation and many are not currently aware of the important work the RBGS does as part of the National Biodiversity Centre (NBC) to conserve Bhutan's unique plant life. Interpretation of the collections, features and landscape of the RBGS offers an opportunity to tell visitors about biodiversity in Bhutan and why it is so valuable. It also provides an effective means of publicising the work of the NBC to the public at large.

In addition to providing the visitor with orientation and information about the Garden, interpretation tries to influence

the way they feel and how they behave. Contact with living things lifts people's spirit and we want visitors to appreciate they are in a special place with a pleasant and peaceful atmosphere. We also want them to refrain from dropping litter, picking flowers or other detrimental behaviour. Interpretation should aim to extend good environmental practice into peoples domestic lives, for example by composting green waste or creating micro-reserves for biodiversity in their own gardens or public open spaces.

Along with raising awareness, benefits to the RBGS from good interpretation include, increased visitor numbers and admission income, a higher media profile and greater appreciation and support from government, non-government and donor agencies.

Objectives

Objectives of the Royal Botanic Garden Serbithang

The objectives of the RBGS are:

- *To act as a conservation (ex situ) area*
- *To act as an educational centre for the Bhutanese flora*
- *To represent the national floral wealth to Bhutanese and outsiders*
- *To act as a recreational area*

The interpretation master plan is relevant to each of these objectives but especially the second one – to be an educational resource

Objectives of the Interpretation Master Plan

Interpretation in the Garden should raise awareness. It should also aim to influence the way people feel about their environment and how they behave towards it. After visiting RBGS and experiencing the interpretation people should:

- *Understand the meaning of biodiversity and know why biodiversity conservation is a priority for the Kingdom of Bhutan*
- *Understand the aims and work of the National Biodiversity Centre (NBC), RBGS, National Herbarium and National Gene Bank*
- *Behave in an environmentally responsible way within the Garden and also in other aspects of their daily lives*
- *Have enjoyed a rewarding and meaningful visit to a place of peace, beauty and tranquillity.*

Themes

There is one over-arching theme for interpretation at RBGS: the Biodiversity in Bhutan, its importance and conservation.

However, this broad theme can be divided into a number of more specific themes and sub-themes that reflect the nature

of the Botanic Garden collections and the work of the National Biodiversity Centre (NBC). The six themes and various sub-themes presented in the table below are examples of priority areas of interest for NBC/RBGS that provide focus the Garden interpretation.

Themes	Sub-themes	Ideas
<i>Plants and people</i>	<i>Plants and medicine Trees, woods & craftsmanship Wild and domesticated fruit trees</i>	<i>The importance of traditional medicine, architecture and craftsmanship to the culture of Bhutan. The value of domestic cultivars in addition to wild genetic resources. The need to manage natural resources in a sustainable way.</i>
<i>Conservation of rare plants</i>	<i>Bhutanese orchids Bhutanese cypress Alpine plants</i>	<i>The special value of endemic and rare plants and the action programmes to conserve threatened and endangered species, including conifers and orchids.</i>
<i>Growing plants</i>	<i>Creating a new botanic garden Greening the urban land</i>	<i>The development of horticulture and social forestry in Bhutan as demonstrated by the creation of a new botanic garden, social forestry and greening school grounds.</i>
<i>Plants in art and religion</i>	<i>Plant motifs in Buddhist art Buddhist conservation ethic</i>	<i>The cultural value of plants as demonstrated by their use in traditional art. Buddhist ideas relating to sanctity of living beings.</i>

<i>Inter-relationships</i>	<i>Pollination</i> <i>Seed dispersal</i> <i>Symbiosis</i>	<i>Ecological relationships, including the interconnectedness of all life and the recycling of all organic materials. Pollination of orchids and rhododendrons as examples of plant – animal interactions.</i>
<i>Biodiversity Action Plan</i>	<i>Ex situ conservation</i> <i>National Herbarium</i> <i>National Gene Bank</i>	<i>The role of the RBGS, herbarium and gene bank in providing an integrated approach to the conservation of plants and animals in support of the Government's BAP for Bhutan.</i>

Audiences

The RBGS is a very popular recreational destination, especially for people from the Thimphu area. As yet there is no accurate estimate of the number of people using the Garden. However, with the introduction of a ticketing system it will be possible to gain a more accurate idea of visitor flow and to plan accordingly.

There is no regular public transport reaching directly to the Garden. Visitors mostly arrive by private car, taxi-bus or coach. It is possible to get a scheduled bus from Thimphu to the end of the Serbithang branch road. After that it is only a short 2km taxi ride.

The audience figures are expected to increase during the next few years as the Garden matures and develops. Currently visitors can be divided into three groups.

- *Bhutanese residents – families, young people and adults from Thimphu and the surrounding area who visit the Garden for recreation and picnics. This activity is weather dependant. The popular season for picnicking is the four or five months from summer to autumn when the Garden is greenest. This period*

might be extended as irrigation in the Garden increases the growing season.

- *Organised groups – primary and secondary school students and their teachers, college students and groups of professional foresters, agriculturalists and others involved in the management of natural resources.*
- *International tourists – foreign visitors on trekking and site-seeing visits who may wish to get some information on the Bhutanese flora and vegetation before travelling on to other more distant parts of the country. The trekking season is governed by weather and festivals. The most popular times are spring and autumn.*

As yet no information exists on visitor's prior knowledge of biodiversity or the work of the NBC or RBGS. This should be established by means of a questionnaire survey. (Further suggestions are included in the recommendations section of the report by the RBGE Interpretation/Education team.) However, it is generally assumed that at present nearly all Bhutanese residents visit the Garden with the prime purpose of recreation and have very little prior knowledge of the real mission of the Garden.

Media

Interpretation media can be divided into live interpretation, exhibits, publications and signage. RBGS offers excellent

Live interpretation

This can take the form of an introductory talk, guided tour, demonstration, workshop or performance. Live interpretation is one of the most effective interpretative techniques as it flexible and allows for interactivity. Talks or tours can be geared towards particular audiences – ages, abilities, language – and weather conditions.

Guided Tours - Several RBG staff already have experience in guiding groups in the Garden but as yet there is no regular tours offered to the public. As the RBG staff are all very busy they will have to confine their activities to meeting specialist and educational groups only. However, the idea of more regular guided tours for the general public, perhaps on Saturday mornings, could be revisited when the Garden has a dedicated education officer.

opportunities for development of interpretation in each of these areas.

Activities and events - Practical demonstrations (for example, taking cuttings or composting), practical activities (for example, games, art classes or making sessions) and performances (for example, drama, music or storytelling) can also be extremely popular and effective ways of presenting ideas on topical and relevant issues. At present the Garden lacks the resources to present such events or activities but they might be possible to present in collaboration with other organisations (see collaboration section).

Special events - If it is impractical to present live interpretation on a regular basis then consideration should be given to taking part wider events such as Social Forestry Day (June 2) or International Biodiversity Day (May 22). One advantage of joining in with these wider initiatives is the publicity that they offer for events at the Garden.

Exhibits

This can take the form of panels, displays, exhibitions or audio-visual media. It has the advantage of being available continuously or on demand without prior booking but has the disadvantage of being less flexible and interactive than live interpretation.

Panels – This is one of the most popular types of interpretation. In recent years technological advances in printing has led to a whole range of new processes and materials. It is now possible to produce high-quality, full-colour panels, incorporating text and illustrations on a wide range of different materials. Manufacturers guarantee a minimum life-span of 5 years, even in outdoor conditions. The cost has also decreased substantially recently. Interpretative panels aimed at a general, non-specialist audience should be clear, attractive and simple in their design. Research has proven that people will rarely read more than 50 words or text. The adage ‘a picture is worth a thousand words’ certainly applies to panel boards. All panel boards intrude on the landscape and they should be used sparingly and sensitively to enhance the aesthetic quality of the Garden.

A proposal for a suite of 12 interpretative panels is given in Appendix 1. A sample outline design is given in Appendix 2. As advanced manufacturing techniques for panels are not available in Bhutan it is recommended that the panels are produced to agreed designs in UK.

Exhibitions – The auditorium in the Information Centre already contains some interesting interpretative displays about the Garden. These could be further developed and enhanced to present exhibits about the Biodiversity of Bhutan, the National Biodiversity Centre, Herbarium and National Gene Bank. An outline plan for a simple exhibition is given in Appendix 3.

Audio-visual Media – A video or other audio-visual presentation is possibly beyond the scope of the first phase of this project but the Information Centre offers potential for showing a film about the work of the Garden, at some point in the future. The Ministry of Agriculture Government Information and Communication Service and the Bhutan Broadcasting Service have film production teams capable of video production.

Publications

Publications include map leaflets, brochures, guidebooks, teacher's guides and more specialised publications. These have the advantage in that they can be read in advance of a visit and can be taken home and reread and consequently reinforce the messages gained during the experience. They can also serve as a souvenir and to help publicise the Garden and its activities.

There are currently no publications available for RBGS. However, it is appropriate to consider the following.

Map leaflet – Visitors entering the Garden need orientation to gain the most from their experience. A simple map leaflet can help present the mission of the RBGS and present some of its principle functions. It also shows the location of the themed areas and enables the visitors to plan a route that will best serve their individual needs. If the leaflet is attractive then

visitors will want to take it home as a souvenir of their visit which will reduce waste and prevent littering.

The production of a map leaflet is included as part of the work included in year three of the Darwin Initiative project. However, as the Garden continues to develop in the future the leaflet will become out of date. RBGS will need to plan and budget for the updating and reprinting of this leaflet in due course.

Brochure/guidebook – a guidebook can provide a lot more information than is available on interpretative panels. Because visitors can take this home and read it at leisure more detail can be included that will satisfy the needs of the more specialist audience or serious student. Although not included in the current phase of the project a guide book might be considered for a subsequent phase as the landscape and collections of the RBGS develop.

Signage and Orientation

Orientation is essential to enable the casual visitor to get the most from a visit to the Garden. This is best achieved through a map panel and welcome panel near the entrance to the Garden, a map leaflet (see above) and direction signs pointing out the principal areas and features.

The RBGS is laid out along a central spine that links the public entrance with the Information Centre and the lower visitor outlook point. This makes orientation relatively simple. A series of sign posts at intervals along the central spine should suffice. The recommended position of signs is shown on the map (page 13) and a list of signs is given in appendix 1.

Corporate Identity

In order to create a good impression the adoption of a corporate identity to provide a uniform and easily-recognisable style to all the RBGS interpretation materials is strongly recommended. Corporate identity usually covers things such as choice of typefaces (fonts), limited and

Signs need to be kept clear and simple and can be made locally. Hand painted local sign painted signs in Dzonghka and English are common in Bhutan. A local sign painter and carpenter could be engaged to produce wooden hand-painted signs to an agreed design and high quality. An example of a hand-painted wooden sign post from Singapore Botanic Garden might that might serve as a suitable model is shown below.

consistent range of colours, use of logos and straplines. The selection of these should be open to discussion but suggestions include:

Typeface – clear and easily read, sans serif font – eg arial (the font used in this document)

Colour – a dark background colour for signs if using white text (maroon seems very popular in Bhutan?)

Logos – NBC, RBGE and Darwin Initiative all have logos that should be used

Sraplines – eg ‘conserving Bhutan’s beautiful biodiversity’

Borders – a border design based on traditional Bhutanese floral designs would make for an attractive and distinct style

Monitoring and evaluation

Monitoring and evaluation of all the interpretation ideas presented in this plan is critical. Evaluation of all new work is best planned in place in three stages.

3. Front end analysis

This has in fact already begun with mini-focus groups of RBG staff, teachers and environmental educators providing opinions on the proposed interpretative themes and various types of media available during the education workshop in July 2004. An example of a questionnaire for testing prior knowledge, themes and media is given in appendix 4.

4.

5. Formative evaluation

Wherever possible all idea should be tried and evaluated first in prototype before proceeding to full development stage. Panels can be produced as basic, laminated versions first

before the final production stage. This will enable remedial action, such as editing, repositioning or redesign, to be taken. An example of a questionnaire for formative evaluation of panels is given in appendix 5.

6. Final evaluation

Visitor's feedback and peer review will enable us to judge the success of the interpretation. In particular we will be evaluating the success of interpretation in meeting the project objectives in terms of increasing visitor's knowledge and understanding and influencing behaviour and emotions.

It is anticipated that the major part of this evaluation will be done by RBGS staff. However, opportunities should be sought to share its experience with others. Students on placement to RBGS could be encouraged to carry out evaluation of exhibits and live interpretation programmes under supervision of their college lecturers.

Staffing

The Interpretation Masterplan has been prepared by a joint team from RBGS and the Royal Botanic Garden Edinburgh (RBGE) under the auspices of the Darwin Initiative. The RBGE has also committed to assist with the implementation of some of the physical interpretation and training. The idea is to lay a solid foundation to interpretation at RBGS. However, for the long-term success of project it is essential that development and implementation interpretation remain under the ownership of the RBGS team. Ultimately project management should be undertaken by an adequately qualified and experienced Bhutanese staff member.

Interpretation Officer – Included within the current 5-year Plan for the development of RBGS is the appointment of an Interpretation Officer. The responsibilities and duties associated with this position should include both formal and informal education and interpretation.

They would be required to have some previous experience in communications and education or undertake training in interpretation techniques.

Training – RBGE run a course in interpretation as part of the Higher National Diploma (HND) course in Plantsmanship. This course is considered to be at an appropriate level and very relevant to RBGS staff. One of the co-authors of this report, IDE, has taught this course for ten years at Edinburgh and also run training courses in a number of botanic gardens for Garden Guides. He can include elements from the HND and Garden Guide course into informal training sessions during his field visits to Bhutan. In addition, there are a number of more specialised course available in UK, Australia and the USA at a variety of levels.

Collaboration

The resources that the RBGS can put into interpretation are limited but there are ample opportunities for collaboration with other government and non-government organisations in Bhutan. Ideally, RBGS should offer a shop-window for Biodiversity in Bhutan and as such it should attract the support of other organisations and agencies that have broadly similar purpose and objectives to the NBC. These include Royal Society for Nature Conservation (RSPN), Worldwide Fund for Nature (WWF), Nature Conservation Department and National Environment Commission.

Special events – other organisations and agencies could be invited to bring displays, demonstrations or activities along to the Garden on special days such as International Biodiversity Day and Social Forestry Day. These organisations will benefit from an attractive space for exhibiting their displays and an interested audience to promote their activities to. RBGS will benefit from the additional visitors and publicity that these special events are likely to attract. RBGS should aim to get media coverage for special events on television, radio and in the press.

Exhibitions – the auditorium offers an excellent space for short- or medium-term exhibitions generated by other government or non-government organisations. These should be relevant to the overall purpose of the NBC but consideration should be given to art and craft exhibitions (for example, paintings or photographs of plants or landscapes by local artists, or displays of baskets or textiles from natural materials) as well as more didactic exhibits. Both art and science have an important place in interpreting biodiversity.

Planning Schedule

Activity	Darwin Initiative Project year 2	Darwin Initiative Project year 3
<i>Interpretation Master Plan</i>	<i>Master Plan written</i>	<i>Master Plan updated</i>
<i>Panels</i>	<i>Text, illustration and design of 12 interpretative panels agreed between RBGS and RBGE</i>	<i>12 Panels designed, fabricated and installed</i>
<i>Exhibition</i>	<i>Ideas for using the Information centre for exhibitions discussed</i>	<i>Plan developed for a small exhibition for the Information Centre</i> <i>Exhibition panels produced</i>
<i>Signage</i>	<i>Proposal for direction signs developed</i>	<i>Hand crafted signs produced locally in Bhutan</i> <i>Signage installed</i>
<i>Map leaflet and panel</i>	<i>Draft designs for map leaflet and panel developed</i> <i>RBGS commission illustrative Garden map</i>	<i>Map leaflet text, illustration and design agreed between RBGS and RBGE</i> <i>Map leaflet designed and printed</i> <i>Map panel produced and installed</i>

<i>Interpretation Officer</i>	<i>Role of an Interpretation Officer discussed</i>	<i>Job description for Interpretation Officer prepared</i>

Appendix 1 - List of interpretative panels and sign posts for RBGS

Proposed Interpretative Panels (* draft text written by IDE)

1. *Welcome/map/ dos and don'ts panels **
2. *Rock Garden and alpine plants*
3. *Rhododendrons of Bhutan*
4. *Orchids of Bhutan **
5. *Prayer Wheel and Cantilever Bridge*
6. *Conifers/Bhutan's national tree **
7. *Bamboo **
8. *Plant propagation*
9. *Plants used in traditional medicine **
10. *Cultivated and domestic fruit trees*
11. *Tree planting and care*
12. *The growing Garden*

Proposed Signage – *position of each sign is marked on the map*

1. *Rock Garden/Rose Garden/ Fruit trees*
2. *Tropical Glasshouse/Prayer Wheel/Clock Garden*
3. *Children's Park/Bhutan Pond/Bamboo Garden*
4. *Orchidarium/Viewpoint/Toilets/Medicinal Garden*

Appendix 2 - An example of the main elements of an interpretative panel

1. Title: *Bhutanese Traditional Medicine*

2. Photograph: *Dried medicinal herbs in the market*

3. Photograph caption: *Dried herbs for sale in Thimpu weekend market*

4. Main text:

Traditional medicine in Bhutan is part of the Himalayan Buddhist culture. Herbs, animal products and minerals are used in medicines and therapeutic practices, like hot baths and massage. More than 300 plant species are used in Bhutanese medicine. To prevent over-exploitation of wild plants a number of herbs have been successfully brought into cultivation.

(54 words)

5. Dzongkha text (*translated into Bhutanese script*):

Growing medicinal herbs in gardens protect wild plants and creates rural employment.

(12 words)

6. Strapline *(to appear on all material)*:

Protecting Bhutan's beautiful biodiversity

7. Logos

NBC, RBGE and Darwin Initiative logo

APPENDIX VII

Darwin Initiative – Royal Botanic Garden Serbithang, Bhutan

Plant Records Report

November – December 2004

The Aims of the Visit.

A team of two plant records staff (Robert Cubey and Janette Latta) visited the garden at Serbithang with the purpose of capacity building with the Bhutanese garden staff to enable them to maintain accurate and useful plant record information.

This would include a review of the existing records which were already in place, followed by training on the importance and uses of plant records, an explanation of accession numbers, database training, garden zoning, temporary labelling and stocktaking. An order was to be compiled for regular batches of engraved botanical labels to be supplied through Edinburgh.

Initial Findings.

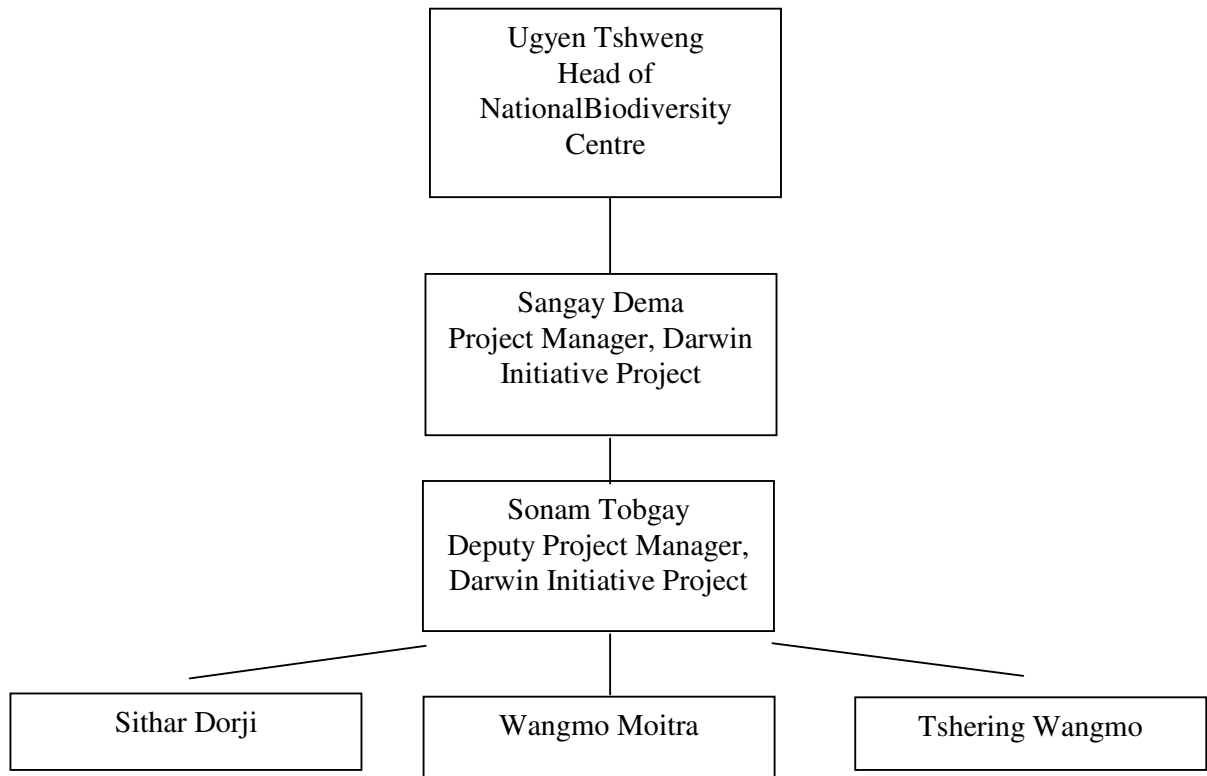
On arrival at the garden in Bhutan, it was evident that the staff there were already aware of the importance of plant records, and were maintaining paper records of accession information. These records had not, however, been matched to the living specimens growing in the garden.

A database had been set up for their use by a volunteer, Chris Watt, which is an adapted copy of BG-Recorder, available through Botanic Gardens Conservation international (BGCI)

Some specimen plants in the garden were labelled with their botanical and common names, family and altitude information; but no labels were in place to link individual plants with their collection information (accession record) Moitra. He will also work alongside Sithar Dorji to incorporate the already detailed information on the orchid collection

Sonam Tobgay has been given the role of database co-ordinator, a role he shows great interest in. He will work with junior members of staff, Tshering Wangmo and Wangmo Moitra. He will also work alongside Sithar Dorji to incorporate the already detailed information on the orchid collection into the database.

Organisational Chart (Simplified)



Developments in Plant Records During Visit.

Computer Hardware and Database Software

After the initial introduction to garden staff and orientation around the site, the computers and database were assessed along with the paper records.

The computer earmarked for database use is relatively old and the power supply intermittent, so some concerns were raised over the safety of the data being held in this machine. Investigations were made into options for data back-up, taking into consideration the availability of storage media in the locality. It was decided to have a CD-writer installed on the computer and this was done during the visit.

The computer also had no printer attached, although an old printer was being kept on a shelf in the room. This printer was attached to the computer and installed (using Windows standard drivers) but it became apparent that this printer was not serviceable. It is recommended that a new printer be sourced for the plant records office in the near future.

The database (BG-Recorder) has been adapted for use by the garden, and some training took place in 2003 of garden staff. However, this has not been followed up by regular usage, so staff could no longer remember how to use the database and new staff had not been trained. Training sessions took place, covering all aspects of the work and are detailed in the section on training.

The standard output reports which were provided within the database had been designed to give summary information on accession records. However, they did not give detailed

information on plants held. These were adapted and some new reports created to give more information on plants held, including numerical counts of actual plants on the ground. We lacked the expertise to attach the new reports to the report menus, but this will be worked on back in Edinburgh with the help of computer database programmers.

Existing records.

A large number of paper records existed on accessions collected in the field. These were held in a number of folders, each representing material collected in a particular year. These records were worked through and, with the exception of around 80 accession records from 2002, were entered into the database during the visit. This data entry was done by a combination of RBGS staff during training sessions and Robert and Janette.

As the staff were very familiar with the plants collected in 2004, a team consisting of Robert Cubey, Janette Latta, Sonam Tobgay and Tshering Wangmo worked through the garden areas, checking and counting individual plants and referencing them to their accession information. As this work was being done, notes were taken to complete the Plant records on these accessions, and tie-on labels were attached to the plants showing the accession number. This work continued until the provided stock of 1,000 waxed tie-on labels was exhausted. It was agreed to supply a further 2,000 labels from Edinburgh so that the staff could continue this work after the visit.

Staff were consulted on the older plantings dating from 1999 to 2003, as to where these plants were put in the garden, so that initial plant records could be made for these accessions also.

A large amount of information is held by Sithar Dorji on the orchid collection in the Orchidarium. This information is to be incorporated into the main database by RBGS staff, most probably by Sithar himself.

Some additional information came to light during discussions, in particular Iris plants and seed introduced in 2004. Accession records and Plant records were created for these. Work still outstanding at the end of the visit (3 December 2004) is listed in Appendix A. All other records were entered into the database by that date.



Checking records and labelling in the garden

Garden Plan and Zoning

The garden does not have an accurate plan of the area and sub-divisions within it. A rough sketch was done showing the general layout and dividing the garden into its composite parts. The areas of the garden were named and numbered according to location codes already set up in BG-Recorder, and some new areas and codes were added. A copy of this plan is posted on the wall of the Plant Records Office at RBGS for use by staff when entering plant records to ensure the correct location codes are used. A computer generated and laminated copy will be provided for use in the field. – See Appendix C.

A detailed scale plan is to be produced by a professional survey technician. This should eventually replace these sketch plans, as hopefully the garden area titles and codes will be included in at least one copy of the scale plan.

Training Sessions.

Training sessions were held during the visit and comprised of a combination of teaching and practical hands on data entry and stocktaking and labelling work.

The work covered is summarised below.

19 November –

Introduction to the database, describing the different record types held in the different tables of the database.

Explanation of why certain types of information are held in each table – for example why details of where material was collected belongs in the relatively ‘static’ accession records whereas information on where a plant is growing and its condition belongs in the more ‘responsive’ plants records.

Initial data entry training – to familiarise the staff with the tables and entry screens.

1 December –

Summary of database record types – to reinforce the earlier training session

Data entry – to reinforce the earlier work and also to enter the information held on paper records

Producing Reports – an introduction to the reports on the database

Stocktaking of garden areas – data entry of work completed in the field to date

2/3 December –

Database review – to ensure all staff had a good understanding of the purpose and structure of the database

Reports – practical training in producing reports and choosing the relevant report for the purpose.

Stocktaking – a summary of how the inventory report can be used as a basis for garden area stocktaking.

Data back-up – instruction on the use of the CD writer to make data back-ups and advice on the regularity of these back-ups.

Some guidance notes were produced for staff to refer to at the time – Appendix A, and these will be incorporated into a set of ‘Method Statements’ of best practice shown as Appendix B

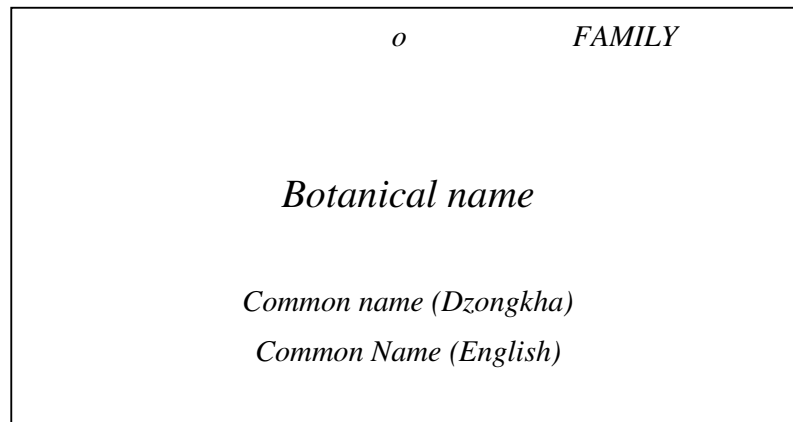
Plant Labels

Although a large number of labels were attached to plants during the stocktaking work, these are of a temporary nature and not ideal for Public display purposes. The Management of the garden at Serbithang had expressed a desire to have engraved botanical labels similar to those used in Botanic Gardens Internationally and an agreement has been made to supply a number of engraved labels through Edinburgh. An initial list of plant names had been drawn up for the first engraved labels, and this was edited to complete any missing data, and agreement reached on the numbers required for each name. The layout and size of the final labels was also discussed and is shown below.

Glasshouse and Orchidarium plants – all medium size (50mm x 75mm)

All outdoor plants – all large size (60mm x 100mm)

All holes to be drilled as for standing labels, as this was deemed to be adaptable for hanging on plants if necessary.
Label layout as shown, white writing on a black background. 'o' shows the hole position.



The first batches of labels are to be produced from the agreed list shown as Appendix D

Dzongkha Script.

The team were given the task of sourcing Dzongkha Script software for use in producing the interpretation panels. After some research, download software was found on the website – <http://education.gov.bt> in zip file format. The internet connection at the garden in Serbithang was not sufficiently stable enough to be able to download this software, so it was agreed to download this in Edinburgh and return a copy to Bhutan by CD-Rom.

Flora of Bhutan.

This publication, produced by RBGE was used extensively to check botanical names and to provide other information used in the names table of the database. Unfortunately, the garden does not have a full set of the books, volumes 2-1 and 3-1 being missing. It was hoped that RBGE may be able to supply copies of the missing books for use by Plant Records staff at RBGS. These books have now been made available free of charge by RBGE along with a second full set of the Flora of Bhutan.

Another book that may prove useful is Bamboos of Bhutan. The price and availability of this will be investigated back in Edinburgh.

Looking to the Future.

Computer Hardware:

- It is recommended that a printer be sourced for installation in the Plant Records Office, or a network connection be made to the existing printer in Sangay Dema's office.
- The keyboard of the machine is sticky and in need of replacement.
- It is recommended that the existing computer hardware be replaced on a rolling programme of, say, 3-5 years to ensure stability of the machine. Any replacement machine should have a CD-Writer installed for data back-up.



Computer with CD-Rom installed for data back-up



Plant Records office desk

Computer Software:

- Edinburgh staff to continue to support and improve the BG-Recorder database to improve data security safeguards and to attach newly designed reports to the report menus.
- Edinburgh staff to provide copy of Dzongkha Script on CD-Rom

Data Entry:

- 'Work Still to do' list for RBGS staff to complete.
- Training to continue during the planned visit by RBGS staff to Edinburgh, based on their own data and database.
- Training Notes and 'Method Statements' to be provided.
- Continued long distance support by email for as long as is necessary.

Garden Plans:

- Accurate scale plan to be drawn up
- Computer-produced, laminated plans for use in field

Labelling:

- 2,000 tie-on labels to be provided to continue stocktaking work.
- Support to be provided in production of engraved labels
- Recommend sourcing local supplier of metal label stands

Conclusions.

We found the staff at RBGS keen and enthusiastic. They all exhibited a good understanding of the need for plant records in a Botanic Garden environment, and had already amassed a large body of accession information on paper. Their enthusiasm was very strong, and we are confident that they will be very capable of taking the records forward and developing them in the future.

The equipment they had available (PC and printer) were fairly old, and a new printer is required. However, they are able to take the task forward in the short term, and we hope that the equipment will be updated on a regular basis to make the task easier. A system of back-ups has been put in place to cover for any equipment failures.





Database training with Sonam Tobgay, Tshering Wangmo and Wangmo Moitra

Darwin Initiative – Royal Botanic Garden Serbithang, Bhutan
APPENDIX A

Training Record

Training took place on 4 days during the visit and involved 4 members of RBGS staff – Sangay Dema, Sonam Tobgay, Tshering Wangmo and Wangmo Moitra.

Notes were produced on report writing and database back-ups and these are included in the method statements at Appendix B

Work still to do at 3 December 2004 was listed for the staff to complete as time was available.

BG-Recorder

Work still to do

3 December 2004

2002 Accessions to complete

2002 Plant records to complete

2004 seeds – accessions to complete and plant records to enter

Orchidarium records – accessions to enter and plant records to enter

Inventory of Garden Areas – check all records already entered

- add any plants and / or accessions not already on the database
- label plants without labels

Print summary reports

Darwin Initiative – Royal Botanic Garden Serbithang, Bhutan
APPENDIX B

Training Notes and Method Statements

1. Record types and database structure
2. Data Entry –
 - 2.1 Genera
 - 2.2 PlantNames
 - 2.3 Accessions
 - 2.4 Plant / clones
 - 2.5 Locations
3. Producing Reports
4. Data Back-up
5. Stocktaking
6. Changing Plant Names
7. Garden Zoning
8. Gridding / Mapping Systems – to be worked on in the future in conjunction with RBGS staff
9. Propagation Information

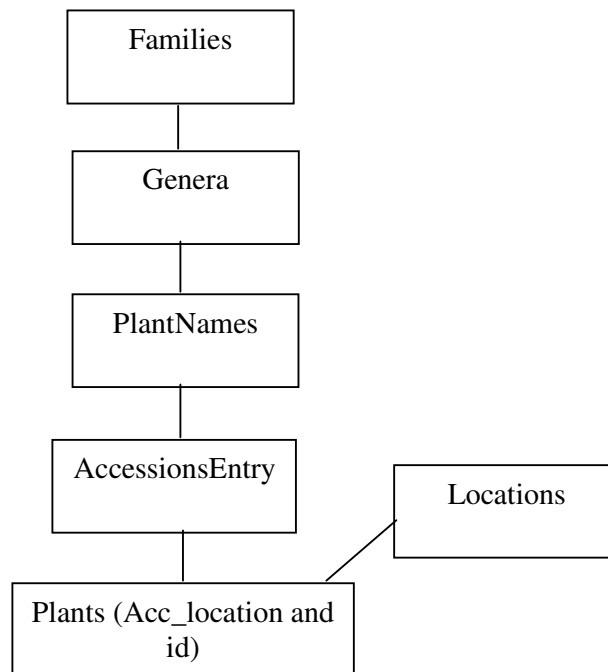
Darwin Initiative – Royal Botanic Garden Serbithang, Bhutan Method Statements

1. Record types and Database Structure

The plant records database holds information in a number of different tables. Each table holds different elements of the information held, and the tables link together to provide the overall picture. For example:

- information on plant nomenclature, authorities, common names, ranges, etc are held in the names file as this information is relevant to every plant bearing that particular name.
- information relating to a particular ‘collection’ of plant material is recorded in that plant’s accession record, such as collection location and staff involved. This information is relevant to all incidences of that particular ‘collection’ regardless of which location they may finally be planted in.

The basic structure of the database is shown in the diagram below.



Each table is dependent on the necessary information being entered in the tables above them in the structure. (ie it is not possible to create a name without first having the Genera in the Genera table.)

The Families table is fully populated and it is fairly unlikely that data entry will be required for this table. Changes at the family level will be infrequent. Changes of family of a genus is more likely and will be covered under Genera table data entry (2.1)

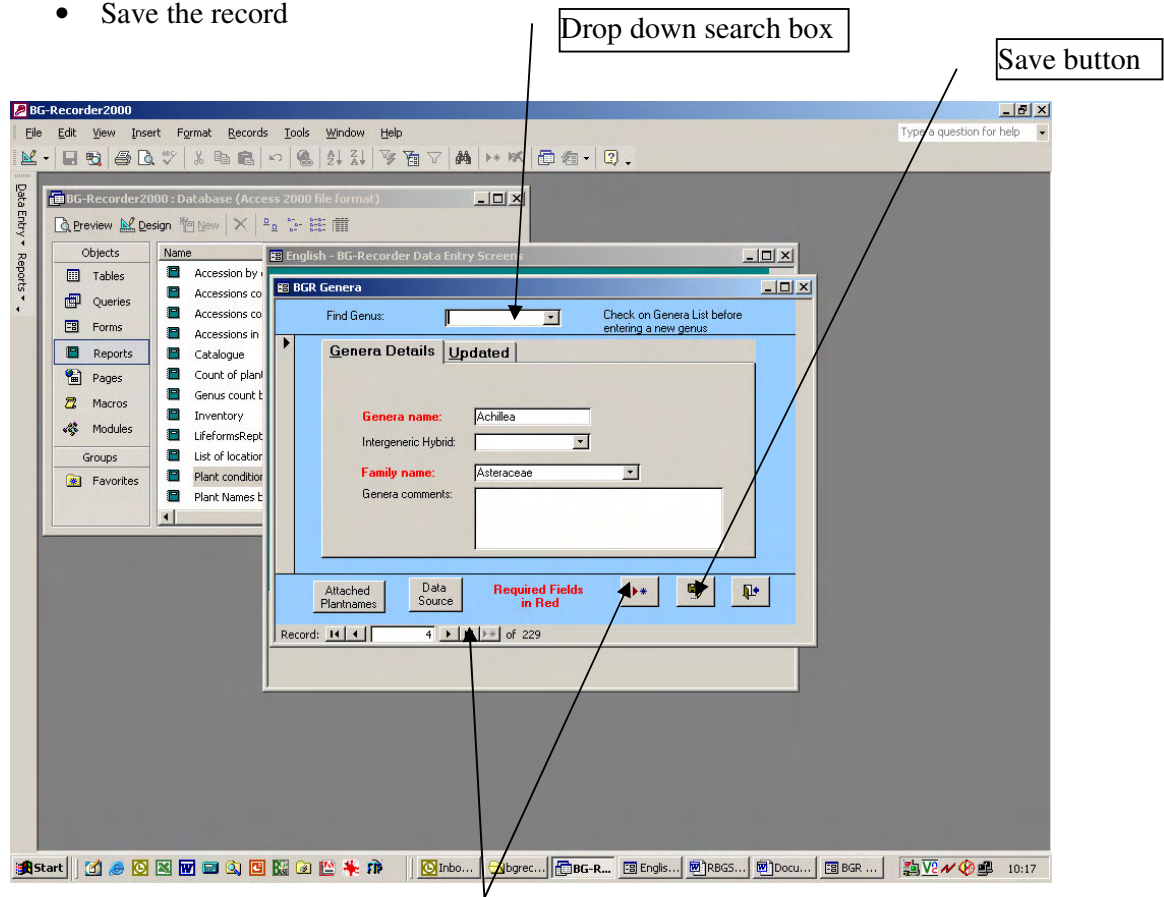
Darwin Initiative – Royal Botanic Garden Serbithang, Bhutan Method Statements

2.1 Data entry – Genera

The Genera table holds genus names and links these to an entry in the Families table.

It is very easy in all tables to accidentally overwrite fields in the first record of the table, as each table opens with the first record already selected. Users must as a matter of course check that they are in the correct record or a new blank record before typing.

- To search for a genus, use the drop down list in the ‘find’ box.
- Before adding a new genus, first search to ensure it is not already in the database.
- To add a genus, create a new record by clicking on the new record icon ‘*’
- Type the genus name, and select the correct family form the drop down list.
- Save the record



Darwin Initiative – Royal Botanic Garden Serbithang, Bhutan Method Statements

2.2 Data entry – PlantNames

The Names table holds information on a scientific name - a combination of genus and species names.

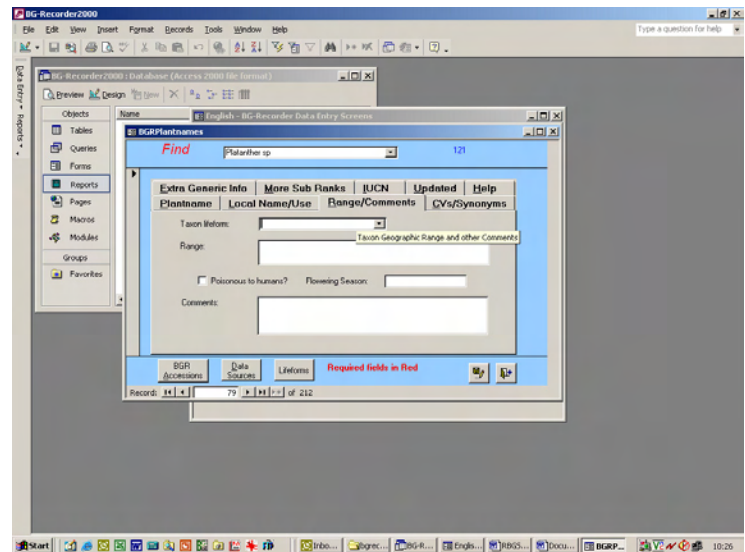
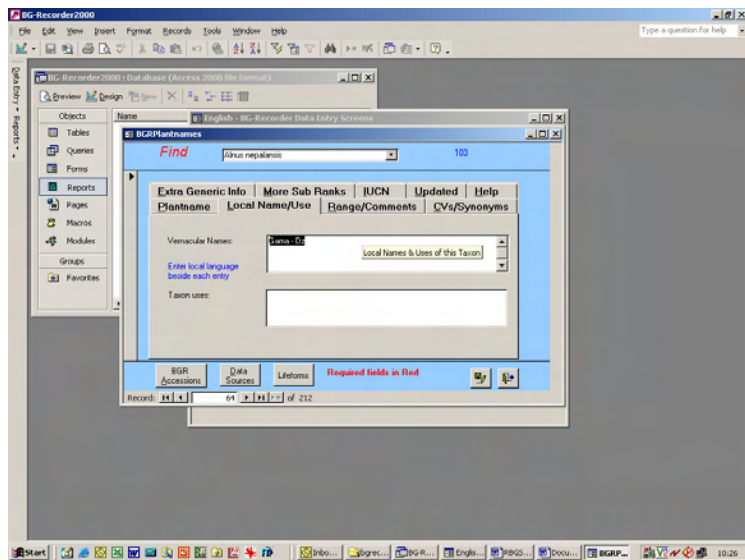
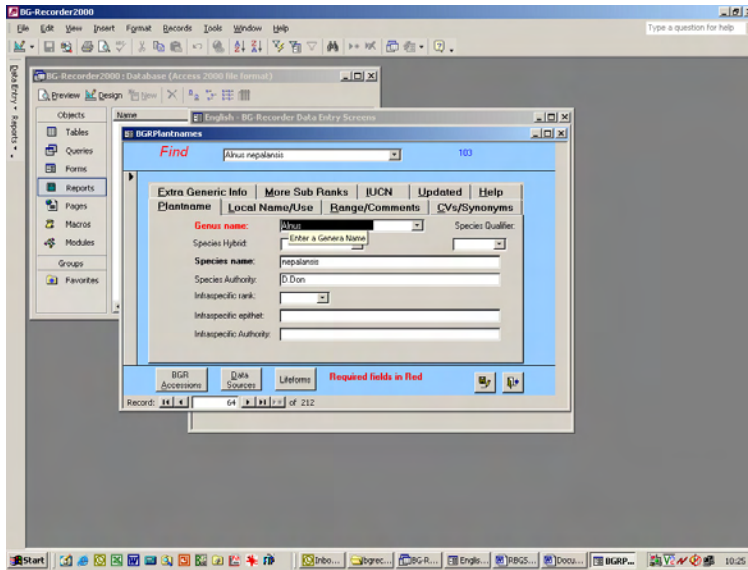
It is very easy in all tables to accidentally overtyping fields in the first record of the table, as each table opens with the first record already selected. Users must as a matter of course check that they are in the correct record or a new blank record before typing.

- To search for a name, use the drop down list in the ‘find’ box.
- Before adding a new name, first search to ensure it is not already in the database.
- To add a name, create a new record by clicking on the new record icon ‘*’
- Select the genus name from the drop down list, type the species name (or sp. if not known) and then fill in details as detailed below.
- Save the record

Details held in the names table:

<u>Essential Fields – must be filled in</u>		<u>Optional Fields</u>
Plantname	Genus (chosen from drop down list)	Authority of name
	Species name (or sp.)	
Local Name/Use		Common names (Dzongkha and English)
		Ethnobotanical uses
Range		Taxon Lifeform
		Range
		Flowering season
		Comments

See sample screens overleaf



Darwin Initiative – Royal Botanic Garden Serbithang, Bhutan

Method Statements

2.3 Data entry – AccessionsEntry

The Accessions table holds information on an accession – a plant or group of identical plants collected at the same time, or a collection of seed or vegetative material collected from the same plant or group of identical plants.

It is very easy in all tables to accidentally overtyp fields in the first record of the table, as each table opens with the first record already selected. Users must as a matter of course check that they are in the correct record or a new blank record before typing.

- To search for an accession, use the drop down list in the search box.
- Before adding a new accession, first search to ensure it is not already in the database.
- To add an accession, create a new record by clicking on the new record icon ‘*’
- The accession number is an eight digit number, the first 4 digits being the year of accessing and the last four being a running number of accessions created in that year.
- Type the accession number, then choose the relevant name from the drop down list. Enter information as detailed below.
- Save the record

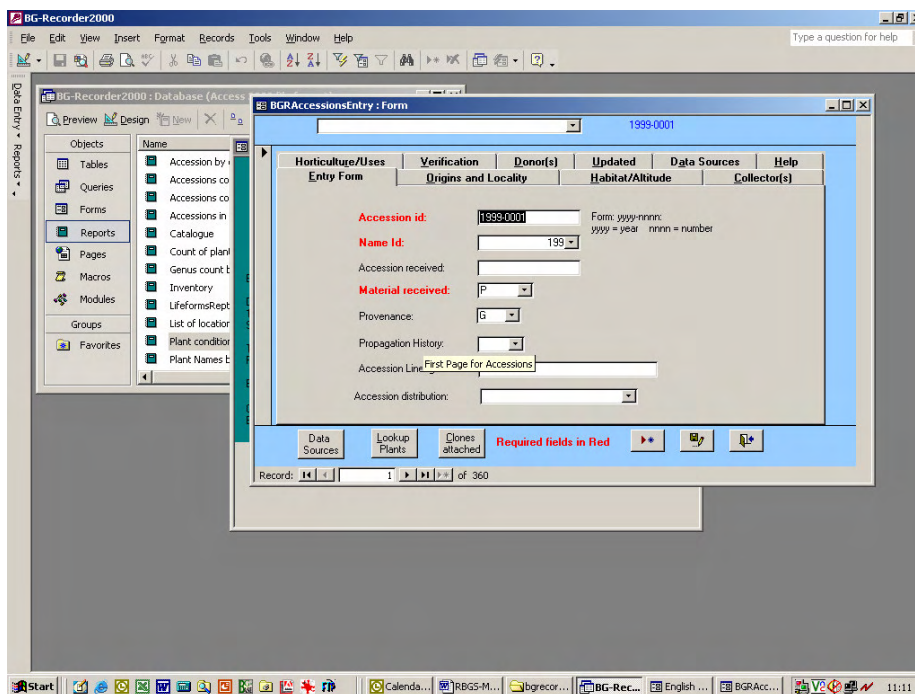
Details held in the accessions table:

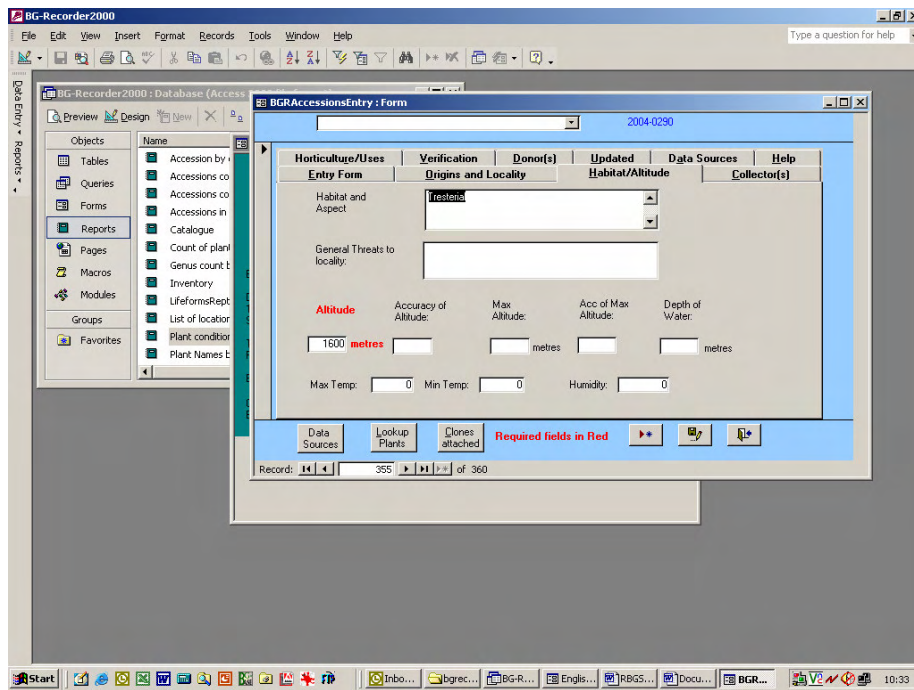
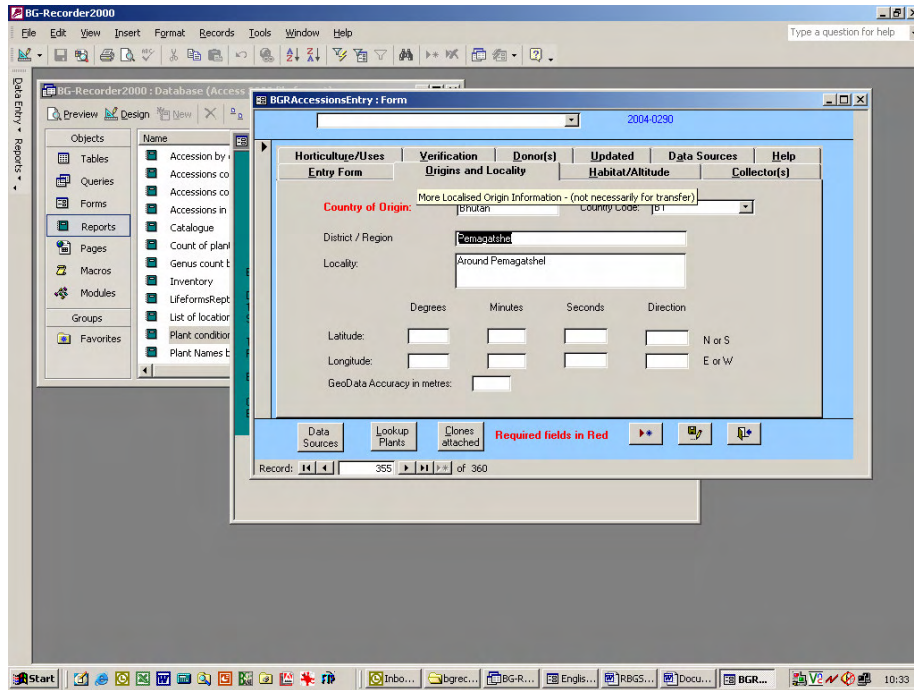
	<u>Essential Fields – must be filled in</u>	<u>Optional Fields</u>
Entry Form	Accession id	Date accession recieved
	Name id (choose from list)	Provenance
	Material received (Plant / seed/ etc)	
Origins and locality	Country of origin	Country code
		District / Region
		Locality
		Latitude / Longitude
Habitat / Altitude	Altitude (in metres)	Habitat and aspect
Collector		Collector’s name

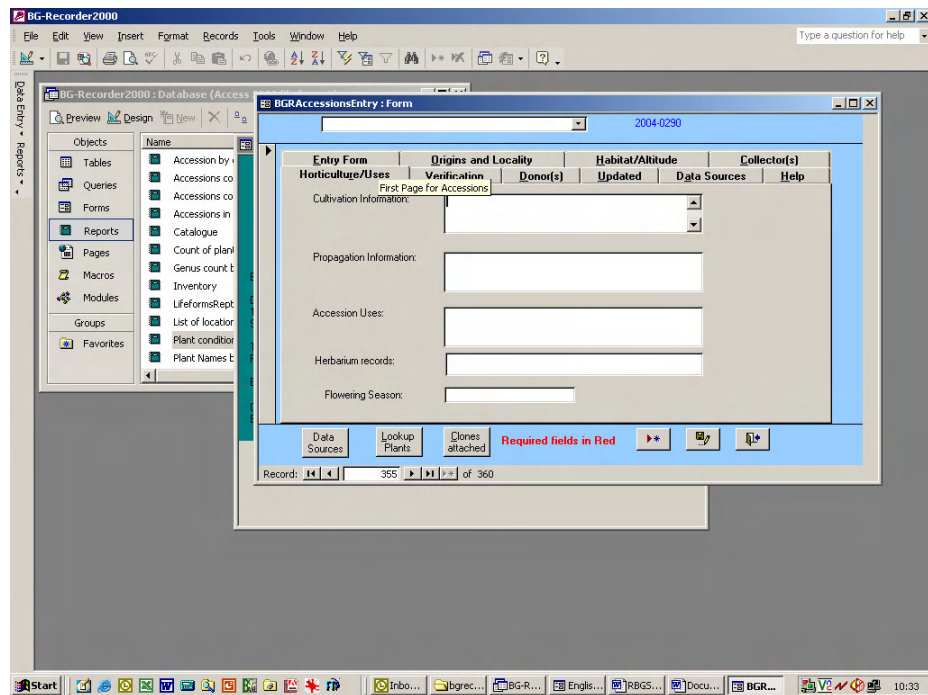
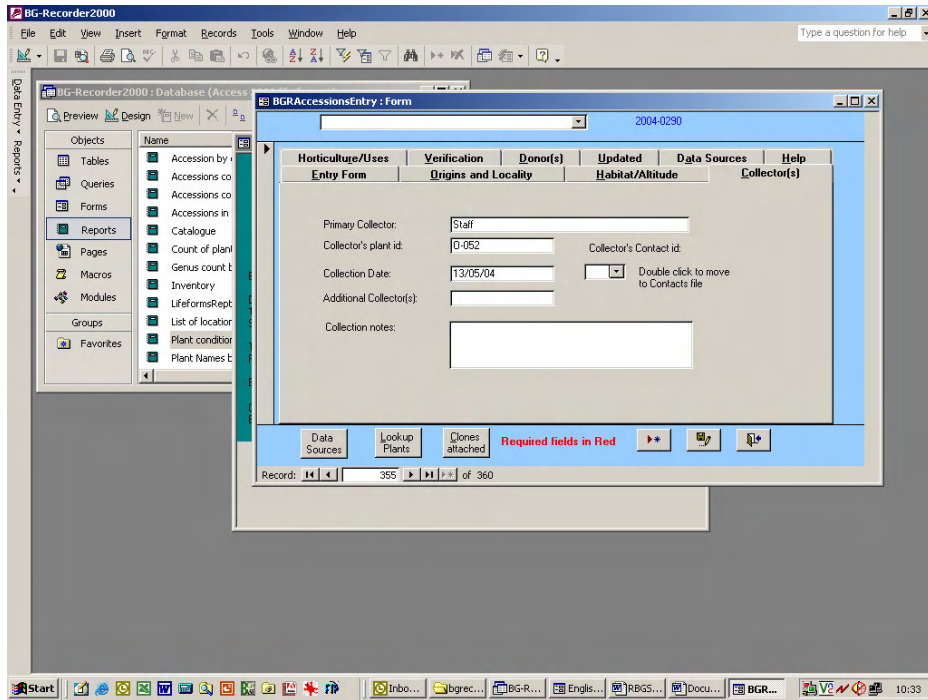
		Collector's id number
		Collection date
		Other collection notes

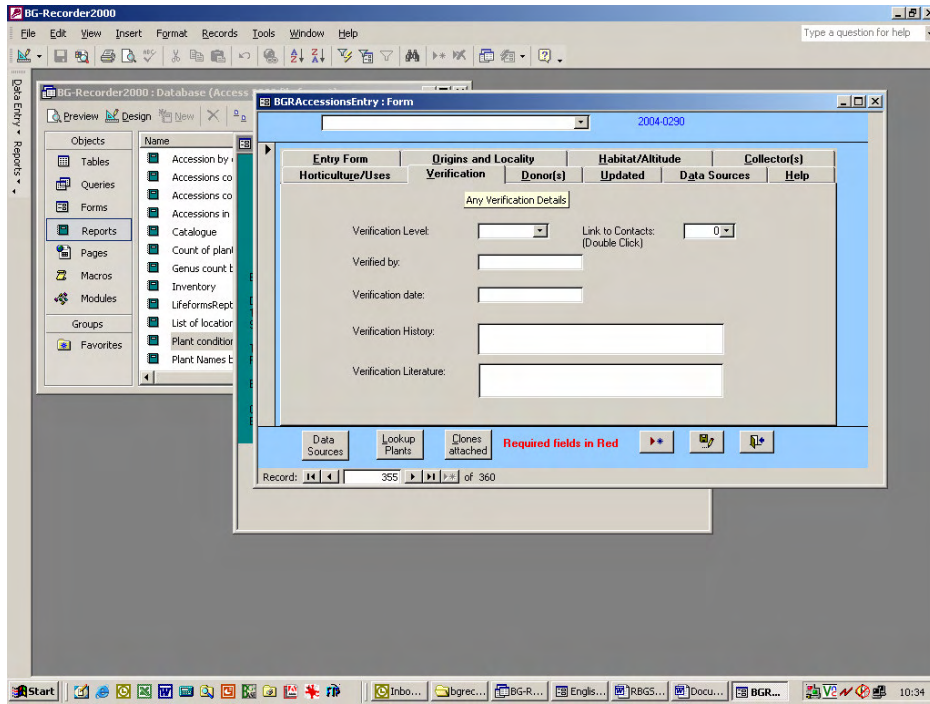
Horticulture / Uses		May be used to store accession-specific information
Verification		May be used to record information on verifications of accessions

See sample screens below









Darwin Initiative – Royal Botanic Garden Serbithang, Bhutan

Method Statements

2.4 Data entry – Plant / clone

The Plants table holds information on individual plants of each accession, so the database can record multiple plants of the same accession at the same or different locations. The information held in the Plants record relates ONLY to that individual. Information affecting all individuals of that accession should be held in the accessions table.

It is very easy in all tables to accidentally overwrite fields in the first record of the table, as each table opens with the first record already selected. Users must as a matter of course check that they are in the correct record or a new blank record before typing.

- To search for a plant, use the drop down list in the search box.
- Before adding a new plant, first search to ensure it is not already in the database.
- To add a plant, create a new record by clicking on the new record icon ‘*’
- Type the accession number and location code (choose from drop down list if necessary) then fill in the information as detailed below
- Save the record

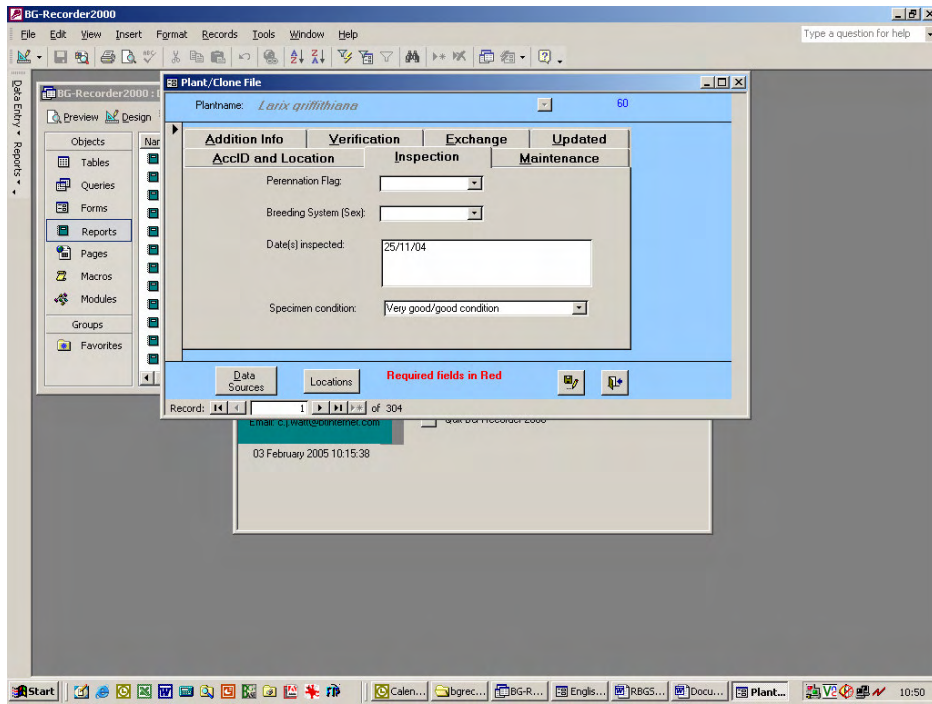
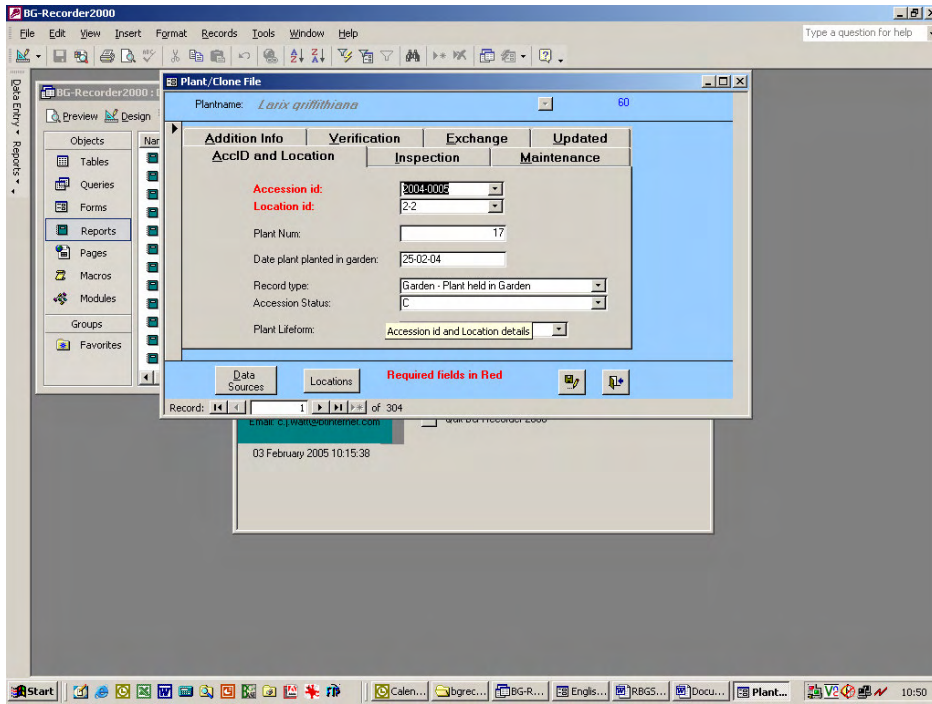
Details held in the plant / clone table:

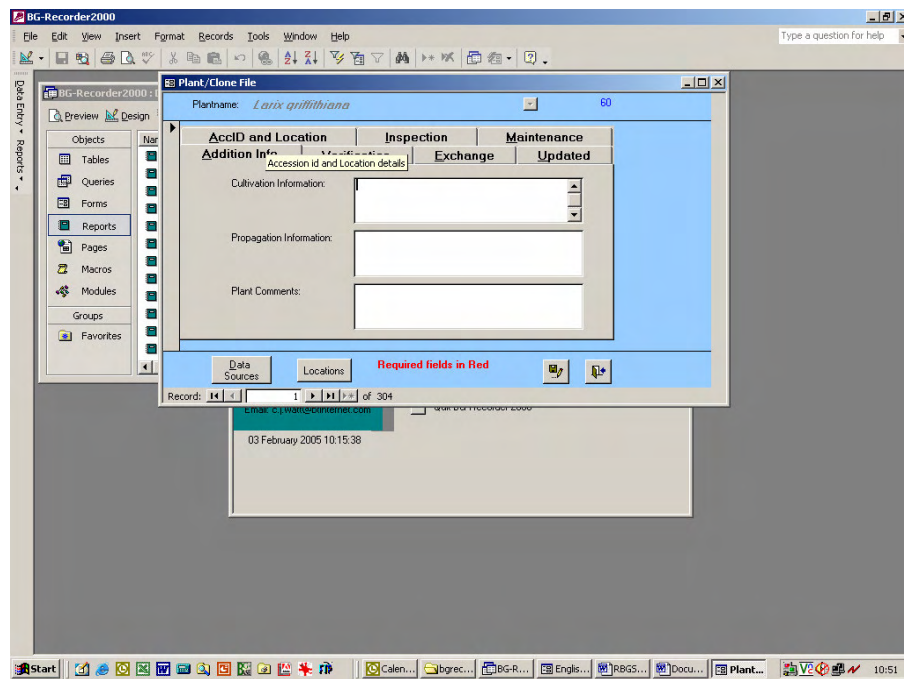
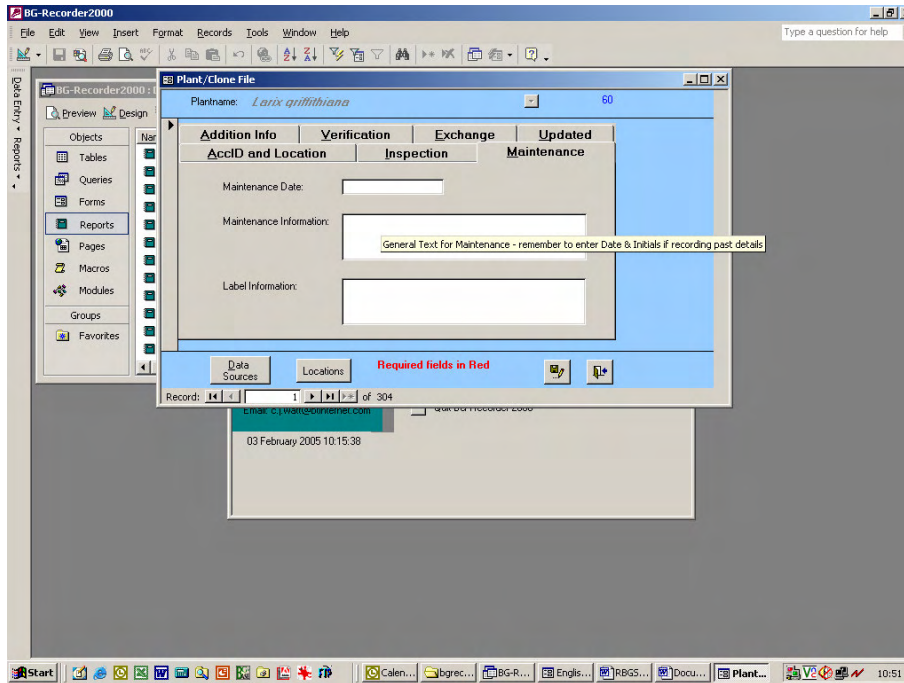
	<u>Essential Fields – must be filled in</u>	<u>Optional Fields</u>
AccID and Location	Accession Number	Date planted in garden
	Location id	Plant lifeform
	Plant num (Number of plants in this location)	
	Record type	
	Accession status	
Inspection		Date inspected
		Specimen condition (choose from list)
Maintenance		Maintenance date
		Maintenance information
		Label information

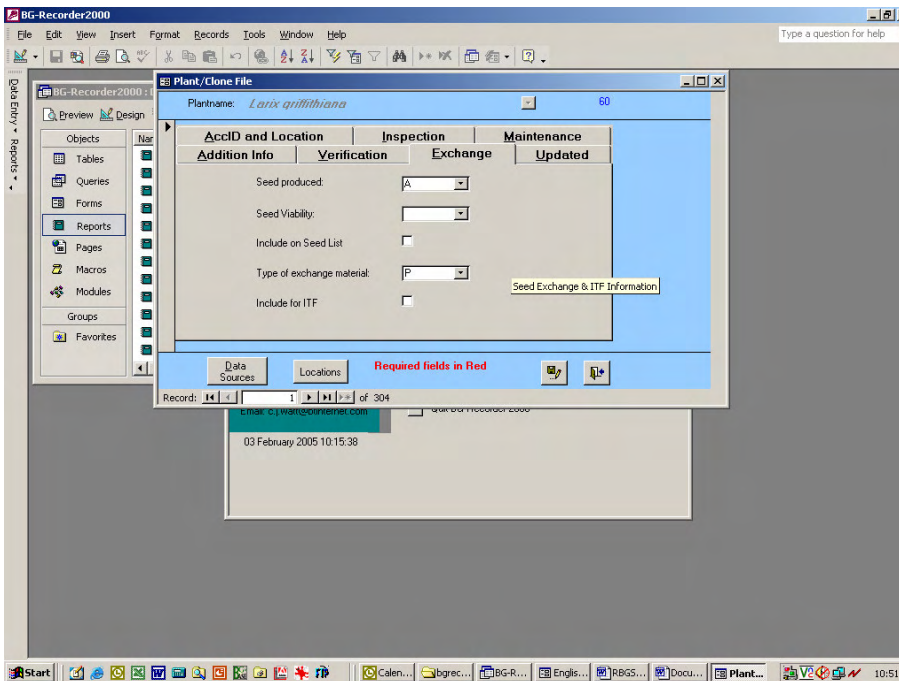
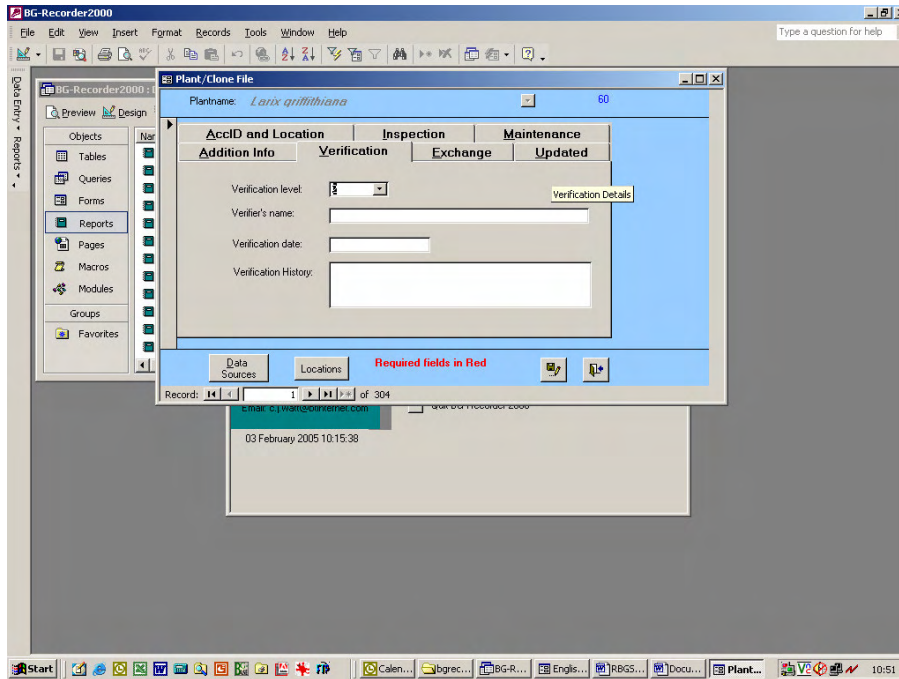
Additional info		Cultivation information
		Propagation information
		Plant comments
		(These fields could be used to record propagation information in the nursery)
Verification		Verification level
		Verifier's name
		Verification date
		Verification history
		(These fields can be used to record verifications on individual plants)
Exchange		(These fields can be used to record plant material given to other organizations)

Note that when a plant dies or is removed, the record should be retained with plant condition 'dead' as the record is still valuable even after the plant has gone.

See sample screens below







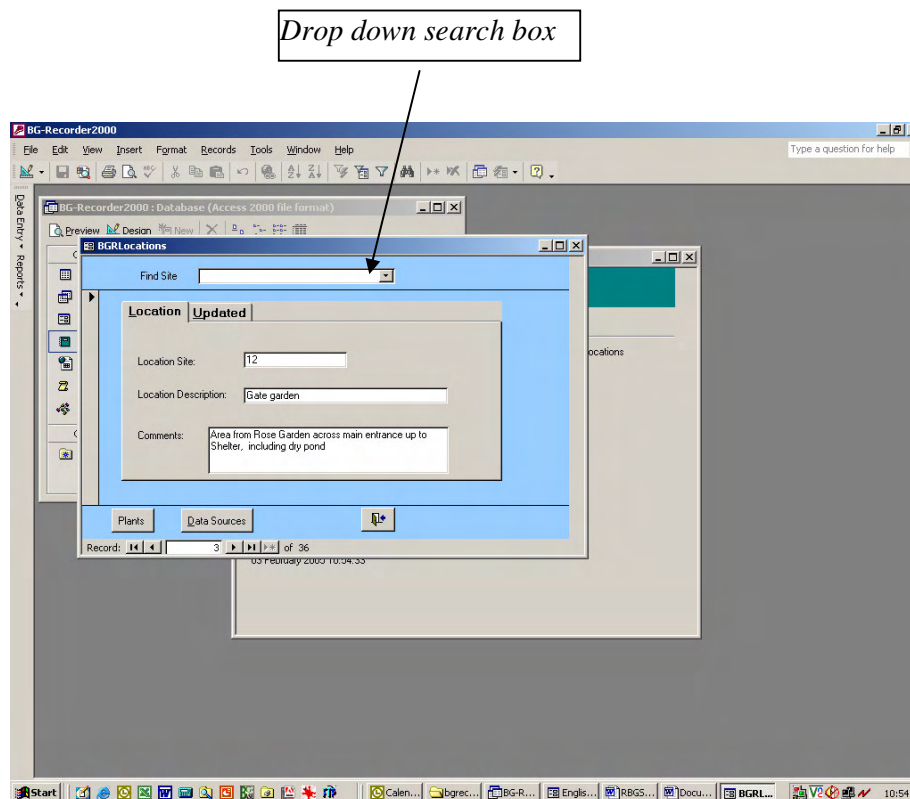
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2.5 Data entry – Locations

The Locations table holds information on locations within the garden. Each location should be defined and, where possible, referenced to a plan of the garden. The location codes define where in the garden an individual plant is, or has been, held.

It is very easy in all tables to accidentally overwrite fields in the first record of the table, as each table opens with the first record already selected. Users must as a matter of course check that they are in the correct record or a new blank record before typing.

- To search for a location, use the drop down list in the search box.
- Before adding a new location, first search to ensure it is not already in the database.
- To add a location, create a new record by clicking on the new record icon ‘*’
- Type the location code and description. Ensure that the new location is incorporated into the garden plan for reference.
- Save the record



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2. Producing Reports

Using Reports to get information from the database.

The database has a report menu. However, the most useful reports do not appear on this. This will be corrected when the database is brought to Edinburgh in January 2005.

Before producing a report, you must first run the programme which collects all of the data together. This programme is called a MACRO.

On the grey coloured screen, click on Macros tab on the left hand bar

2 Macros will appear

Run both macros by double clicking on them – answer yes to all 3 questions that appear

To choose a report, click on reports on the left hand bar. The 4 most useful reports are described below. There are other reports available, which RBGS staff can study and choose whether they may be useful, however they do not provide information on numbers of plants, which is probably the most regularly used information.

1. Inventory – produces an inventory list of the whole garden, sorted by location.

This report shows a list of plants in each location. The details shown are: Family; Botanical name; Accession no.; Date last checked; Plant condition and no. of plants.

This report will be useful for providing a list of the plants in a location to use for stocktaking (inventory) work.

To print only one area instead of the whole garden, save the report into Word and then delete those areas you do NOT wish to print. Note that deleting information in Word does not affect the data in the BG-Recorder database.

To save to Word, click on the ‘W’ icon at the top of the screen and reply ‘Yes’ to the query box.

While the printer attached to the computer in Sonam’s office is not working, you will need to save the Word file to a floppy disk and transfer it to another machine for printing.

2. Catalogue – produces a report of all plants in the garden sorted by Family and then Plant Name

This report shows all plants arranged by taxonomic groupings and shows Accession no.; Botanical name; Common name; Date of last inspection; Plant condition and no. of plants.

This is a summary of the whole collection which you may wish to print off at regular intervals – say once a year at the beginning of January – and keep in a file as a record of the collection at that time.

3. Count Plants by Location – produces a report which lists the total no. of accessions and total no. of plants in each area

This report is a summary of the variety of plants held in each area. It provides a useful quick count of accessions and plants and may also be printed periodically to keep on file.

4. Accessions in a Year – produces a list of all accessions sorted by year

This report shows what plants were collected or acquired in each year. The report shows Accession no.; Family; Botanical Name; Provenance of the accession (Wild or not wild); The Region of collection; the Locality of collection and the Altitude.

The details are sorted first by year and then by accession no.

This report will be useful to identify what has been collected in a specific year and also to find the next available accession no. when creating new accession records for a particular year.

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Data Back Up to CD

The working copy of the database is held only on the computer in Sonam's office. It is held on the hard drive of the machine (c:)

To prevent against loss of data if that machine breaks down, the data must be backed up regularly.

'Backing up' is making a copy of the database at regular intervals to another disk. At RBGS use the CDRW ('Back Up of Database')

Regularity of back ups depends on how often data is being entered. While data is being entered, we recommend to back up at least once per week.

To back up to CD

<p>Double click on 'Nero' icon Put CDRW ('Back up of Database') into Samsung CD Writer (blue) Choose 'compile new disk' Choose 'Data CD' Choose 'New CD' Finish</p>

2 screens will appear side by side.

The right hand screen is the files on the machines hard drive (c:)

The left hand screen is the files on CD (d:)

Click once on BG-Recorder and pull across to the left hand screen using the mouse

Click on the button that says 'Burn CD' (red)

Wait for the message 'Burn Process Completed Successfully'

Click on 'Discard'

Close software, without saving changes (Say 'No' to questions)

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5. Stocktaking

Plant stocktaking is the regular checking of all plants in a particular location. This is necessary to check the accuracy of your plant records, to assess the general health of the collection and to check labelling is still in place.

First of all, produce an ‘Inventory’ report detailing the plant records for the particular location you plan to work in.

Working methodically, check every plant listed:

- Check it/they are labelled and the accession number agrees with the label
- Agree or amend the number of clones present
- Agree or amend the plant condition
- Update the date of checking
- Add any comments you think necessary

Where a plant is listed but no longer present:

- Change the plant condition to ‘dead’ with a comment if the cause of death / removal is known.

Where you find a plant in the location that is not listed:

1. If it has an accession number and it is marked on the database as dead:
 - Change its condition to a live code and amend as for live plants
2. If it is recorded in a different location:
 - Amend the location id on the plant / clone record
3. If it has an accession number but is not recorded:
 - Create a new plant record as per Method Statement 2.4
4. If it has no accession number:
 - Create a new accession record, incorporating as much information as it is possible to collect on the plant
 - Create a new plant record, again incorporating as much information as is possible
 - Label the plant

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6. Changing Plant Names

As a result of scientific work on the collection and identification of plant material, the names of plants in your collection will change from time to time.

Remember that although a plant is renamed, its accession number will, in most cases, be unaffected. The name should be changed in the accession record, and this will filter down to all plant records of that accession.

Where more than one plant with the same accession number should clearly have different names, then a subsection of the accession (ie one or more of the plants records that are different from the bulk of the accession or the original collection descriptions) will need to be reaccessed and the new name be attached to the new accession number. These reaccessed plants will need to be relabelled. The old records should be marked as 'deaccessed' with a comment stating their new accession numbers.

If a plant name changes as a result of a verification, details of the verification (verifier, date, etc) should be recorded in the plant / clone file

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7. Garden Zoning

The garden is divided into zones or locations to aid staff in finding a particular area or plant.

The zones are allocated a location code as well as a description detailing where that location is. These locations should also, preferably, be shown on a garden plan or map.

The garden at Serbithang is divided into a number of areas which are listed below. These locations can be further sub-divided in the future as necessary as the number of plants grows and it becomes more difficult to find plants within a particular location. Another way to aid plant finding within a location is with the use of a mapping system, which can be devised to suit the ground conditions and equipment available (see Method statement 8). Mapping requires some input of capital and time, but a simple gridding system can produce a method of finding a plant with some degree of precision.

Garden areas at RBGS (reference garden plan):

1. Orchidarium
2. Arboretum – split into
 - 2.1 Oak zone
 - 2.2 Conifer zone
 - 2.3 Deciduous zone
 - 2.4 Broadleaved zone
3. Medicinal Garden
4. Nursery – divided into
 - 4H Upper nursery
 - 4L Lower nursery
5. Bamboo Garden
6. Fruit Garden
- 6a. Upper Fruit Garden
7. Rose Garden
9. Rock Garden
10. Bhutan Pond
12. Gate Garden
13. Ornamental Garden
14. Rhododendron garden
15. Economical Garden
16. Lawn
17. Information Office (beds around)
18. Memorial Garden
19. Vista points – divided into
 - 19VL Lower Vista point
 - 19VH Upper Vista point
20. Primula Garden
21. Wild Garden
22. Staff Gate Garden
27. Fern Garden
28. Feed and Fodder Garden
29. Glasshouse
30. Car Park
31. Clock Garden

32. Pond area
33. Entrance Lawn
34. Informal Garden
35. Areabelow Upper Nursery
36. Aquatic Garden

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8. Gridding / Mapping

A way to aid plant finding within a location is with the use of a mapping system, which can be devised to suit the ground conditions and equipment available. Mapping requires some input of capital and time, but a simple gridding system can produce a method of finding a plant with some degree of precision.

An advantage of using such a system is in quickly locating an individual plant in a highly populated area, or to ascertain the identity of a plant which has lost its label (using the grid references of the plants around it to work out which plant record relates to that one individual).

One simple method of gridding is to create imaginary rows and list the plants in the order they appear while moving left to right, front to back along these rows. This is used in Edinburgh and has been demonstrated to RBGS staff.

It has the disadvantage of being subjective in character and difficult for a second person to produce exactly the same grid.

A more accurate method is a mapping system where the precise location of the plant can be recorded using GPS or equivalent. This is very accurate and two people will always get the same result, but requires investment in equipment to measure the locations. If an accurate scale plan of the garden is available, the plants can then be plotted onto the plan to show their location in the garden using specialist mapping software.

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9. Propagation Information

Below is a list of the propagation information currently collected and stored at RBGE. This can be used as a guide to what information could be collected and stored at RBGS using the Additional Info screen in the plant / clone table or the Horticulture / uses screen in the AccessionsEntry table.

Propagation requested by whom
Date of propagation request
Date plants needed
Type of propagation – Seed / cutting / graft
Date of propagation
Special treatments – hormone / heat / cold
Number treated
Date of germination / rooting
Date of potting
No of successful plants
Cause of death
Propagation complete – plants moved to garden

APPENDIX E

Royal Botanic Garden Serbithang

Darwin Initiative Project

Record of work covered in November-December 2004 visit

18 Nov 2004 - Meet with staff and orientation tour of Garden
Agree Itinerary with Sangay Dema
Meet with Director – Dr. Ugyen Tshweng – to approve itinerary

Notes from diary:

- Map Engineer estimated cost \$100
- Lower nursery polytunnel moved and brickwork built for Propagation house (Note position not as in plan)
- Rhododendrons in area below Upper nursery suffering (probably exposure to winds)
- Rhododendrons in Rhododendron area by staff gate look much healthier.
- Glasshouse and Orchidarium look healthy and well maintained.
- Pond has been re-built with stone sides and concrete base – to be painted blue.
- Clock faces brought back by Sangay from Japan for clock tower – 2 in hand, 2 to receive.
- Sonam Tobgay to be in charge of database, using Wangmo, Tsiring and Sithar to provide and enter data.
- Water pipe hanging over lower fruit garden – needs to be directed underground.
- Ongoing soil improvement in plant pits. Pits shallower with added organic matter and mulching.
- Development of windbreak planting in arboretum
- Recent plantings – estimated 80% success rate.

19 Nov 2004 - BG-Recorder. Look at database and set up on Sonam's PC
Initial training with Sangay, Sonam, Tsiring and Wangmo
Covered database structure, different tables, data entry.
Rough sketches of garden layout for plan
Purchased paper, pencils and rubber to make initial drawing

Notes from diary:

- Glasshouse closed due to theft of Cacti by visitors (sign excluding entry without permission)
- Sonam PC – Windows 98SE, Sangay PC Windows 2000 (Word 2000)
- 1 type of plant collected from 1 location in one day = 1 Accession
- Seed from 1 plant = 1 accession
- BG-Recorder data – 63 Names (151 Genera, 729 families)
 - 50 Accessions
 - 53 Plants – deleted and started from scratch

20, 21 November 2004 - Visited vegetable market
Paid Travel Agent for Druk Air tickets
Changed money at Bank
Went to Cinema
Drew first draft of Garden area plan

- 22 November 2004 - Entered Names records for 2002, 2004 accession records (paper)
 Started top enter accession records for 2004
 Prepared paper temporary labels for 2004 accessions
 Checked Plan of garden areas with Sonam
 Amended locations file for new locations added
- 23 November 2004 - Entered accessions for 1999 and 2003 (part)
 Stocktaking and labelling for areas – 2004 accessions only:
 14 (Rhododendron Garden)
 22 (Gate Garden)
 34 (Informal Garden)
 29 (Glasshouse)
 9 (Rock Garden)
- 24 November 2004 - Completed accessions for 2003
 Stocktaking and labelling for area – 2004 accessions only:
 2-4 (Broadleaved zone)
- 25 November 2004 - Entered accessions for 2004 (part)
 Stocktaking and labelling for areas – 2004 accessions only:
 2-2 (Conifer zone)
 2-1 (Oak zone)
- Notes from diary: - Barbeque at night in garden. Cooking doen by seed bank staff.
- 26 November 2004 - Completed 2004 accessions
 Entered Plant records for 2004 accessions (part)
 Stocktake and labelling for areas – 2004 accessions only:
 12 (Gate Garden)
 31 (Car Park area)
 7 (Fruit Garden)
 4H and 4L (Nurseries)
 15 (economical Garden)
 3 (Medicinal Garden)
 14 (Lawn area)
- 27 November – Field Trip to Dochu La and Lamperi
- 28 November – Fruit and Veg Market for gifts and souvenirs, Football match.
 2nd copy of plan produced for Garden use
- 29 November 2004 – Stocktaking and labelling of areas – 2004 accessions only:
 2-3 (Deciduous Zone) with help form scientist to identify
 bare twig plants.
 2-4 (Broadleaved zone) – complete plants not found earlier
 Completed Plant records for 2004 accessions
- 30 November 2004 – Entered 2002 Accessions (part)
 Discussion – locations of 1999 accessions
 Engraved Label order:
 Entered paper list into Works database.
 Added altitudes information and filled in missing common names

Discussion of label order – layout, size, numbers of each name.
Printer driver installed on Sonam's PC (Win 98 disk borrowed)
Price agreed with supplier for CD writer at 2800 Ng.

- 1 December 2004 - CD-writer installed
Entered 2002 Accessions (part)
Entered 1999 Plant records
Training session:
Overview of database table types
Data entry
Walkround with Director.
- 2 December 2004 - Training Session:
Summary of work covered
Data entry
Plan and location records amended for additional areas.
Entered additional 2004 accessions and plants (seed recorded in
Wangmo's diary)
Worked to improve layout of reports
Label order completed and copy printed for reference.
- 3 December 2004 - Training Session:
Summary of work covered
Report Printing
Stocktaking
Name Changes
Data Back-up
Training notes typed for part of session. Balance to be forwarded.
Sithar Dorji help with notes on 2003 collections (where planted)
Discussion on Orchidarium records
Refresher training with Sithar Dorji on data entry and database
structure.
Production of 'Work Outstanding' List
Entered 2003 Plant records

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APPENDIX F

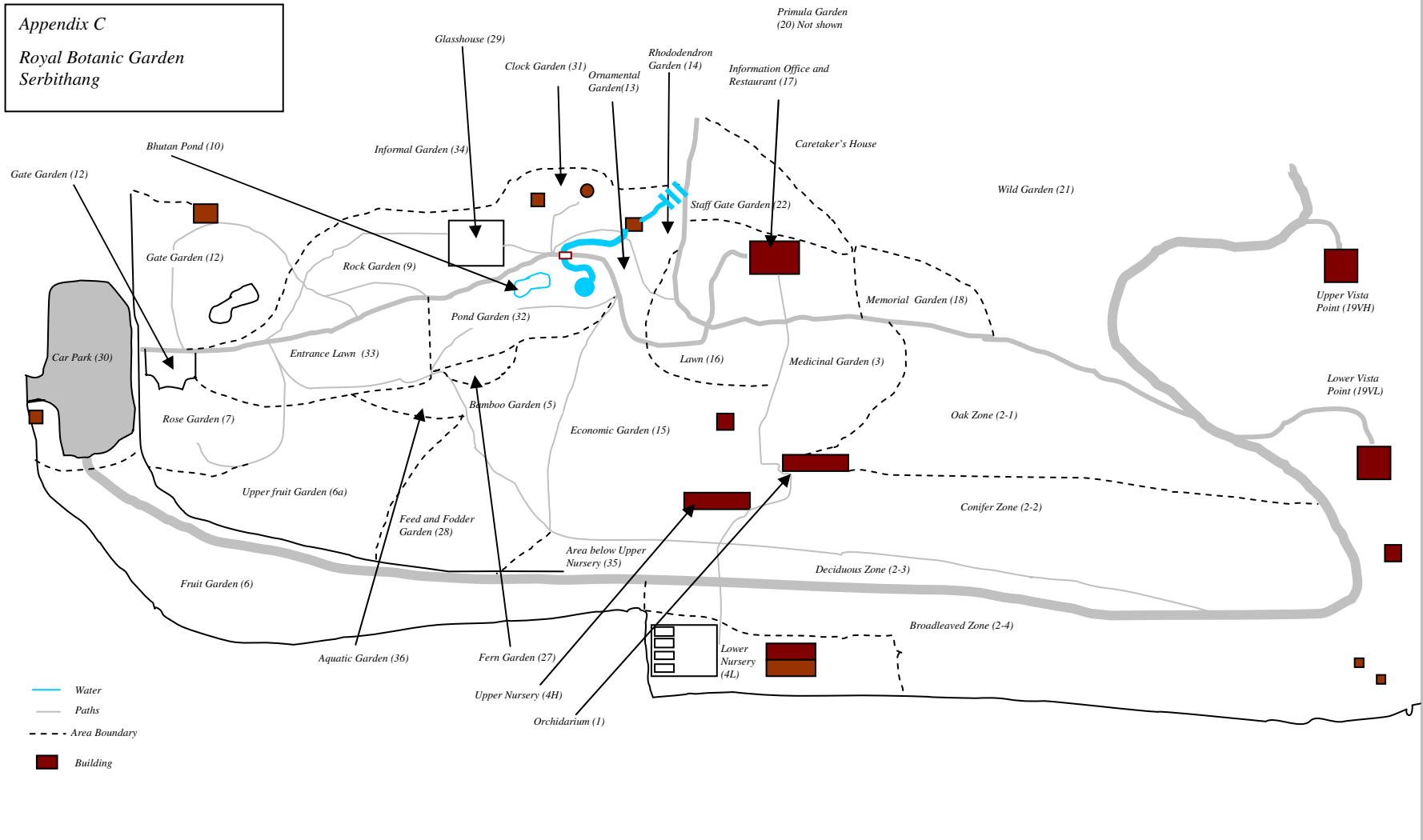
Database Statistics at 3 December 2004

Total no of accessions	182
Total no of plants	1482
Taxa	88
Families	51

See sample reports overleaf

Appendix C

Royal Botanic Garden
Serbithang



Appendix D - Label order

Acer campbellii	Maple	Chalam	Aceraceae	2000-3050	Bhutan	Large	Stand	2
Rhus semialata	Chinese gall	Choka Shing	Anacardiaceae	915-2745	Bhutan	Large	Stand	2
Ilex dipyrena	Himalayan Holly		Aquifoliaceae	2000-3120 (4000)	Bhutan	Large	Stand	2
Colocasia esculenta	Taro	Dho	Araceae	90-2690	Bhutan	Medium	Stand	2
Araucaria araucana	Monkey puzzle		Araucariaceae		Chile	Large	Stand	2
Berberis asiatica		Kepai Tsang	Berberidaceae	1400-2300	Bhutan	Large	Stand	1
Mahonia napaulensis			Berberidaceae	1525-3000	Bhutan	Large	Stand	2
Alnus nepalensis	Nepalese alder	Gama	Betulaceae	1600-2300 (3300)	Bhutan	Large	Stand	1
Betula alnoides		Taap	Betulaceae	2000-2900	Bhutan	Large	Stand	1
Betula utilis	Indian paper birch	La Taap	Betulaceae	3000-4200	Bhutan	Large	Stand	1
Leycesteria formosa	Himalayan honeysuckle		Caprifoliaceae	1524-3658	Bhutan	Large	Stand	1
Leycesteria glaucophylla			Caprifoliaceae	2400-2896	Bhutan	Large	Stand	1
Viburnum cylindricum		Aetra	Caprifoliaceae	1410-2743	Bhutan	Large	Stand	1
Euonymus sp.			Celastraceae		Bhutan	Large	Stand	1
Cornus capitata	Dogwood	Phoetsee Shing	Cornaceae	1830-2900	Bhutan	Large	Stand	3
Cupressus corneyana	Weeping cypress	Tsenda	Cupressaceae	2550-3000	Bhutan	Large	Stand	2
Cupressus torulosa	Himalayan cypress		Cupressaceae	2550-3000	Bhutan	Large	Stand	2
Juniperus recurva	Weeping Blue Juniper	Shup	Cupressaceae	2900-4200	Bhutan	Large	Stand	2
Juniperus squamata	Flaky Juniper		Cupressaceae	3200-4700	Bhutan	Large	Stand	2
Thuja orientalis	Chinese Arbor-vitae		Cupressaceae		Bhutan	Large	Stand	1
Daphniphyllum chartaceum		Juroo Shing	Daphniphyllaceae	1600-2290	Bhutan	Large	Stand	1
Eleagnus parvifolia		Bji	Eleagnaceae	2100-3000 (3100)	Bhutan	Large	Stand	2
Hippophae salicifolia	Sea Buckthorn	Tare	Eleagnaceae	2133-2755	Bhutan	Large	Stand	2
Ephedra Gerardiana			Ephedraceae	3700-4200 (2500) 2700--3100 (3200)	Bhutan	Medium	Stand	2
Enkianthus deflexus	Flame of the forest	Shing Marp	Ericaceae		Bhutan	Large	Stand	1
Lyonia ovalifolia		Zentu Shing	Ericaceae	1500-2600	Bhutan	Large	Stand	2
Pieris formosa		Khepchhey	Ericaceae	1830-3960	Bhutan	Large	Stand	2
Rhododendron anthopogon	Rhododendron		Ericaceae	3700-4200	Bhutan	Large	Stand	1
Rhododendron arboreum	Rhododendron	Aeto Metog	Ericaceae	2100-3000 (3100)	Bhutan	Large	Stand	1
Rhododendron ciliatum	Rhododendron		Ericaceae	2900-3350	Bhutan	Large	Stand	1
Rhododendron falconeri	Rhododendron	Khangley Metog	Ericaceae	2500-3200	Bhutan	Large	Stand	1
Rhododendron kesangiae	Rhododendron	Tala Metog	Ericaceae	2890-3450	Bhutan	Large	Stand	1
Rhododendron maddenii	Rhododendron		Ericaceae	1800-3000	Bhutan	Large	Stand	1

Rhododendron setosum	Rhododendron		Ericaceae	2770-4800	Bhutan	Large	Stand	1
Rhododendron thomsonii	Rhododendron	Khempa Metog	Ericaceae	3050-4000	Bhutan	Large	Stand	1
Quercus glauca	Oak	Thonp	Fagaceae	1100-2100	Bhutan	Large	Stand	2
Quercus griffithii	Oak	Si-Si Shing	Fagaceae	1300-2500	Bhutan	Large	Stand	2
Quercus lanata	Oak	Ghum Shing	Fagaceae	1500-2200	Bhutan	Large	Stand	2
Quercus semicarpifolia	Oak	Bji Shing	Fagaceae	2400-3200	Bhutan	Large	Stand	2
Swertia petiolata		Pitta	Gentianaceae		Bhutan	Medium	Stand	1
Gingko biloba	Madenhair Tree		Gingkoaceae		China	Large	Stand	2
Corylopsis himalayana		Grong Grongmo Shing	Hamamelidaceae	1800-2560	Bhutan	Large	Stand	2
Hydrangea aspera			Hydrangaceae	1000-2133	Bhutan	Large	Stand	1
Hypericum sp.			Hypericaceae		Bhutan	Large	Stand	1
Illicium griffithii	Star Anise	Dhom-leeshi	Illiciaceae	1800-2460	Bhutan	Large	Stand	1
Juglans regia	Walnut	Ta Shing	Juglandaceae	1800-2500	Bhutan	Large	Stand	2
Acacia dealbata	Mimosa, Silver Wattle		Leguminosae		Australia	Large	Stand	2
Piptanthus nepalensis			Leguminosae	2300-3650	Bhutan	Large	Stand	2
Robinia pseudocasia	Locust Tree	Chha Shing	Leguminosae	1200-2500	Eastern USA	Large	Stand	1
Magnolia campbellii		Haley Metog	Magnoliaceae	2000-3100	Bhutan	Large	Stand	1
Magnolia globosa		Kokre chanp (nep)	Magnoliaceae	2800-3100 (3300)	Bhutan	Large	Stand	1
Michelia champaca	Yellow champa	Kha-shing	Magnoliaceae	200-600	Bhutan	Large	Stand	1
Melia azedaroch	Persian Lilac	Ju-Shing	Meliaceae	300-2320	Bhutan	Large	Stand	2
Morus macroura	Mulberry	Tshende	Moraceae	900-2000	Bhutan	Large	Stand	1
Musa sp.	Banana	Ngalaa Shing	Musaceae	200-1000 (1200)	Bhutan	Medium	Stand	1
Musa sp.	Banana	Ngalaa Shing	Musaceae	200-1000 (1200)	Bhutan	Large	Stand	1
Callistemon lanceolata	Bottle brush		Myrtaceae		Australasia	Large	Stand	2
Ligustrum confusum	Privet	Jangtse Shing	Oleaceae	1200-3050	Bhutan	Large	Stand	1
Forsythia x intermedia			Oleaceae	2380		Large	Stand	1
Abies densa	East Himalayan Fir	Dungshing	Pinaceae	3000-4000m	Bhutan	Large	Stand	2
Cedrus deodara	Deodar Cedar		Pinaceae		Western Himalayas	Large	Stand	2
Larix griffithiana	Sikkim Larch	Za Shi	Pinaceae	2400-3600	Bhutan	Large	Stand	2
Picea spinulosa	East Himalayan Spruce	Seh Shing	Pinaceae	2400-3600	Bhutan	Large	Stand	2
Pinus bhutanica	Bhutan Pine	Drug-gi-tongphu	Pinaceae	1750-2440	Bhutan	Large	Stand	1
Pinus roxburghii	Chir Pine	Theytong	Pinaceae	900-2000	Bhutan	Large	Stand	1
Pinus wallichiana	Blue Pine	Tongphu	Pinaceae	1700-3300	Bhutan	Large	Stand	2
Tsuga dumosa	Himalayan Hemlock	Ba Shing	Pinaceae	2400-3300	Bhutan	Large	Stand	2
Cotoneaster microphyllus	Little-leaf Cotoneaster	Chharoo Shing	Rosaceae	2100-4570	Bhutan	Large	Stand	1
Malus domestica	Apple		Rosaceae		Bhutan	Large	Stand	1
Potentilla nepalensis		Saley dem	Rosaceae		Bhutan	Large	Stand	1
Prinsepia utilis		Dushi Tsang	Rosaceae	2100-3000 (3100)	Bhutan	Large	Stand	1

<i>Prunus persica</i>	Peach	Kham	Rosaceae	250-2800	Western China	Large	Stand	1
<i>Rosa sericea</i>		Sew Shing	Rosaceae	1220-3800	Bhutan	Large	Stand	2
<i>Spiraea micrantha</i>			Rosaceae	2200-3800	Bhutan	Large	Stand	1
<i>Populus sp.</i>	Poplar		Salicaceae			Large	Stand	1
<i>Salix babylonica</i>	Weeping willow	Changma	Salicaceae	2700-3800	Bhutan	Large	Stand	2
<i>Symplocos sp.</i>	Sweetleaf		Symplocaceae		Bhutan	Large	Stand	1
<i>Taxus baccata</i>	Yew	Ha Shing	Taxaceae	1800-2700 (3500)	Bhutan	Large	Stand	2
<i>Cryptomeria japonica</i>	Japanese cedar	Jatsen Shing	Taxodiaceae	1200-2000	Japan	Large	Stand	2
<i>Daphne bhoulua</i>	Daphne	Dhey Shing	Thymelaceae	(3100) 3300-3800	Bhutan	Medium	Stand	2
<i>Dioscorea sp.</i>	Yam		Dioscoreaceae	1980-3400	Bhutan	Large	Stand	1
<i>Buddleja sp.</i>	Buddleja		Buddlejaceae		Bhutan	Large	Stand	1
<i>Primula sp.</i>	Primula		Primulaceae		Bhutan	Large	Stand	1
<i>Melastroma sp.</i>			Melastomataceae		Bhutan	Medium	Stand	1
<i>Oroxylum indicum</i>		Champaka Shing	Bignoniaceae	300-2100	Bhutan	Medium	Stand	1
<i>Bombax ceiba</i>	Silk Cotton Tree		Bombacaceae	200-1300	Bhutan	Medium	Stand	1
<i>Sapindus rarak</i>	Soapberry	Nakapani	Sapindaceae	350-1400	Bhutan	Medium	Stand	1
<i>Murraya koenigii</i>	Curry leaf tree		Rutaceae	200-2850	Bhutan	Medium	Stand	1
<i>Pandanus sp.</i>	Pandanus		Pandanaceae	200-1000 (1200)	Bhutan	Medium	Stand	1
<i>Mangifera indica</i>	Mango	Amchukuli	Anacardaceae	200-1500	Bhutan	Medium	Stand	1
<i>Ficus religiosa</i>	Sacred ficus	Sha	Moraceae	300-500	Bhutan	Medium	Stand	1
<i>Diplazium polypodiodes</i>	Fiddle-head fern		Woodsiaceae		Bhutan	Medium	Stand	1
<i>Saccharum officinarum</i>	Sugar cane	Guchu, Gunchha	Andropogonaceae		New Guinea	Medium	Stand	1
<i>Justicia adhatoda</i>	Malabar nut		Acanthaceae	200-1610	Bhutan	Medium	Stand	1
<i>Colocasia esculenta</i>	Coco yam	Taro	Araceae	90-2690	Bhutan	Medium	Stand	1
<i>Coleus sp.</i>			Labiataeae			Medium	Stand	1
<i>Croton sp.</i>			Euphorbiaceae			Medium	Stand	1
<i>Capsicum sp.</i>	Chili Pepper		Solanaceae		Bhutan	Medium	Stand	1
<i>Sarcococca sp.</i>			Buxaceae		Bhutan	Large	Stand	1