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DRAFT
Environmental Impact Statement

Appendix 13

Big Indian Resort and Spa Recommendations for Landscaping on Elevated Structures

The Belleayre Resort at Catskill Park

BIG INDIAN RESORT and SPA

RECOMMENDATIONS
for
LANDSCAPING
on
ELEVATED STRUCTURES

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Date: December 20, 2001

BIG INDIAN RESORT and SPA

LANDSCAPE PROJECT OUTLINE

Section *i.* General Observations

Section 1. SOIL HANDLING AND PLACEMENT

Section 2. ROOF ASSEMBLY SUGGESTIONS

Section 3. PROJECT WATER BALANCE

Section 4. IRRIGATION SYSTEM SCHEMATIC DESIGN

Section 5. FERTILIZATION REGIMEN AND RECOMMENDATIONS

i. General Observations
This report covers subjects applicable to the landscape materials placed on elevated structures at the project. Treatment of material planted at ground level is not covered in that this material only requires normal landscaping procedures.

The area to be planted covers approximately 5+ acres on five separate structures, each forming a portion of the building roof.

The tiered setback configuration is such that only the roof on which the observer is standing is visible to the observer. Lower roofs are obscured by the roof edge and parapet. For this reason, the landscape design should favor eye-level viewing primarily.

Although xeriscape plants are being considered, an irrigation system is proposed. Xeriscape plants only require less water than other plants, but they do require water nevertheless. In a ground level landscape, moisture evaporated from the surface is partially replaced by capillary action from deeper reserves. There will be no reserves on the elevated structures, and soils can be expected to dry out deeper and faster than at ground level.

Moreover, the irrigation system will permit a wider range of plant species than just those that are drought tolerant. Consistent with water conservation, non-xeriscape plants can be spotted here and there and their singular water requirements met by individual taps from the drip system.

The mature size of the plants used must be taken into consideration. Trees taller than about 6 feet over-all height will begin to obscure views from upper structures. Also, as trees get larger, they get heavier. Larger trees also are more susceptible to wind loading and are more likely to be toppled or uprooted in gusty wind conditions.

The weight of most of the plant material will be insignificant when compared to the crushed stone and soil structure required for their success. Using the proposed light weight soil mix, the imposed dead load from these materials will average about 72 pounds per square foot dry, and about 92 pounds per square foot wet for soil and about 44 pounds additional per square foot for the crushed stone, wet or dry.

Mulching is recommended as a water conservation measure and to reduce the need for weeding. At initial installation, a shredded hardwood bark mulch would be appropriate at a depth of 2" to 3". However, this type of mulch will decompose over time and so must be renourished periodically, a major undertaking given the areas to be covered. For this reason, it is recommended that a ground cover ("green mulch") be installed as part of the initial planting. The ground cover will eventually mulch the soils and take the place of the shredded mulch as it decomposes.

Landscape maintenance will be a major consideration from the outset. To minimize intrusion into guest areas, maintenance must be reduced as much as possible. That is, applying occasional fertilizer and rare pesticide chemigation through the irrigation system, mulching for weed control, selecting plants that hold their morphology for the longest possible time, and selecting plants that are most resistant to local pests and prevalent diseases. Use of annuals should be avoided as they will need to be removed after frost and replaced again in the next growing season, all of which increases roof traffic and contributes to the compaction of the soil mix.

Selecting the correct soil and mix amendments is important. The project will require approximately 11,000 cubic yards of soil mix. Processing and placement will be a major undertaking, and a mistake here will be very costly. Imported topsoil will be necessary and so a full chemical analysis is highly recommended. If soil amendments are necessary, they will be most conveniently added during processing rather than after placement.

The material that follows contain recommendations that are derived from trade practice and experience. They are recommendations only and are not intended in any way to preempt the decisions and selections by the project's professional design team.

End of Section i

1. SOIL HANDLING & PLACEMENT

1.a General Considerations

The roof area used in the following discussion is 240,123 square feet (s.f.) as noted on Drawing A-003 of July 31, 2001.

An analysis of planting depths will determine the amount of topsoil required by the project which is done in this report section. See **Paragraph 1.c** below.

In that the project is located on a plateau, it is unlikely that sufficient native soil will be recovered to replenish the site to the depths required. That being the case, imported topsoil will be necessary. If any native top soil is available, it may be used as underlayment to the imported material.

Imported topsoil must meet certain conditions if it is to perform satisfactorily in this application. They are:

> Soil which can (or did) pass a 1" screen.
>
> Soil composition (ratio of clay/sand/silt) should fall within the "Loam" or "Clay Loam" envelope of the soil structure diagram, See **Drawing 1.1**. Soil structure nearer the clay axis is preferred for better water retention and root anchorage.
>
> The natural pH of the soil should fall approximately between 6.0 and 7.5. While nutrient deficiencies can be overcome by fertilizer design, it is nearly impossible to permanently alter the natural pH of a soil, and pH excursions outside these values will limit the selection of plant species.

The soil supplier must provide a chemical and structural analyses of the soil being offered. The test(s) should be performed by a recognized laboratory regularly engaged in such work and reviewed by the Landscape Architect. The analysis must be homogeneously representative of the entire soil lot or multiple samples should be submitted.

Many agricultural extensions, particularly those affiliated with universities, offer this service free of charge. If this service is not locally available, one of the most widely used laboratories is:

> A&L Southern Agricultural Laboratories
> 1301 West Copans Road, Building D, Suite 8
> Pompano Beach FL 33064 - Tel 954 972 3255

The analysis will provide the basis for designing the fertilizer regimen so it is important that this information be obtained. See **Section 5. FERTILIZATION REGIMEN AND RECOMMENDATIONS.**

Soils may be purchased already amended with manure, compost or some other organic filler. These are acceptable although the filler should not be used in the calculations for light weight amendments because organic fillers will decompose over time.

If organically amended or artificial soils are offered, the composition and chemistry should be examined by a horticulturist.

1.b Planting Considerations
The amount of soil to cover the wet roof area will depend upon the depth which, in turn, depends on the mature size of the material to be planted. In general, the following is recommended:

Bedding plants & ground cover - 12" soil depth (which should also be the low point for the surface drain inverts).

Small shrubs from 12" to about 24" overall height - 12" soil depth.

Larger shrubs and small trees to 3' to 4' overall height - 18" soil depth.

Small trees to 6' overall height - 24" minimum soil depth.

Trees or shrubs over 6' in mature height is not recommended except in areas sheltered from prevailing winds, or unless the natural morphology is such that the leaf mass offers little or no wind resistance.

For larger shrubs and small trees, the soil depth requirement is not only to allow root development but to also provide sufficient anchorage so that the plant material is not uprooted in windy conditions.

When mounding for larger plants, the width of the mound should equal the mature leaf or branch spread of the plant. See **Drawing 1.2.** If multiple adjacent plants require mounding, the mound should be in the form of a continuous berm instead of a series of small hills.

Note that gusting, during a thunderstorm for example, may uproot or topple some plants anyway, particularly small trees. See the anchoring detail in **Drawing 1.2** for guying suggestions to help prevent this.

1.c Quantity Requirements
The exact quantity of soil will depend in the mix of sizes of the selected plant material which is unknown at this time. An algorithm using percentages is possible at this point however.

Assuming the plant mix to be:

25% Bedding plants & ground cover	72,037 s.f. @ 12" depth	60,000 cu.ft.
35% Small shrubs	96,049 s.f. @ 12" depth	72,000 cu.ft.
30% Larger shrubs, and small trees	48,025 s.f. @ 18" depth	126,000 cu.ft.
10% Larger trees to 6'	24,012 s.f. @ 24" depth	48,000 cu.ft.

A total of 306,000 cu.ft, or 11,000 cubic yards would be required for the above mix of plant sizes.

To simplify the recalculation if necessary, the landscape architect should be asked to provide the percentages of plants according to the above categories or to provide his calculations if different from the above.

1.d Soil Amendments

The most important soil amendment goal in this project is to reduce the roof dead load while still providing conditions whereby plants will be successful.

Light weight soils are commonly used on elevated structures for this purpose and numerous methods are in use which add inert fillers to the soil. Inquiries should be made to determine local practice. One of the simplest and most direct is to add about 25% by volume expanded mica. Expanded mica is sold commercially under the generic trade name "Vermiculite." "Perlite," an expanded mineral similar in appearance to styrofoam beads, is also used but has a tendency to "float" to the surface over time and collect in terrain low points. Horticultural grade Vermiculite has a density of about 9 lbs/cu.ft., dry and about a 52% by weight water retention capacity

A 25% ratio of filler to soil by volume would require 2,800 cu.yd. of Vermiculite or equal and 8,200 cu.yd. of soil. If possible, the soil and filler should be mixed off site and delivered to the project in a form ready to be placed.

N.B. In specifying the expanded mica, select only products labeled as horticultural grade. The expanded mica used as blown-in building insulation for example has a high pH and should not be used.

Vermiculite not only reduces the wet and dry soil weight but has the added advantage of maintaining most of the unamended soil's water retention capacity, an important factor in reducing irrigation cycles. For example:

	Natural topsoil	Amended topsoil
Dry weight	69 lbs/cu.ft	54 lbs/cu.ft.
Saturated weight	100 lbs/cu.ft.	78 lbs/cu/ft.
Water Retained	3 gal/cu.ft	2.8 gal/cu.ft.

Lighter weight can be achieved by increasing the proportion of amending material although, as the mix becomes lighter, the likelihood of uprooted plants becomes greater.

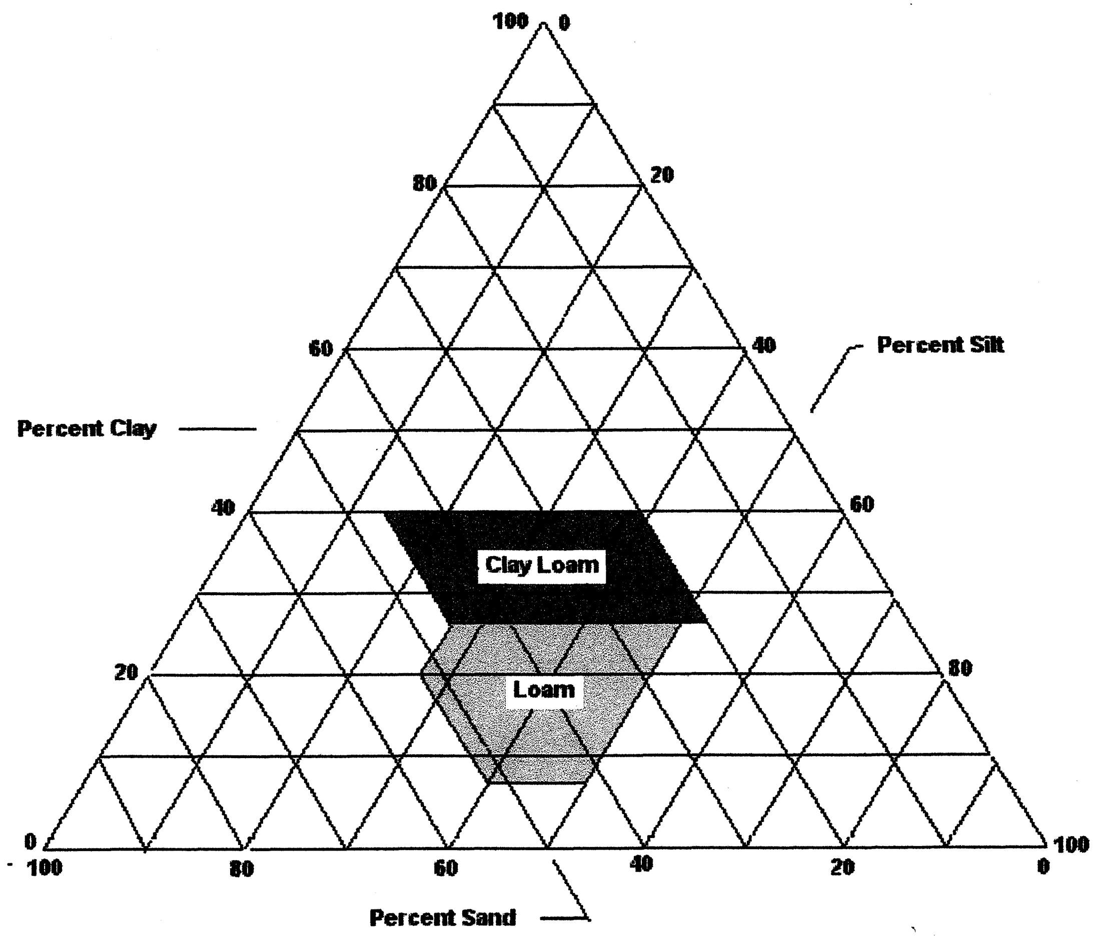
1.e Soil Placement
Soil must be placed beginning at the farthest point from the roof access. Every effort must be made to avoid compacting the soil by vehicle or excessive foot traffic. If it is necessary to move materials over placed soil, the imposed weight should be spread out by using plywood sheeting as traffic ways, and repetitious traffic should use different routes each few trips if at all possible.

If the soil has been freshly sifted or mixed with expander, it will contain an amount of entrained air which will cause the soil to shrink as it settles. Allow about 10% settlement to achieve final grade, or conduct a simple wet/dry volume test to obtain a more exact figure.

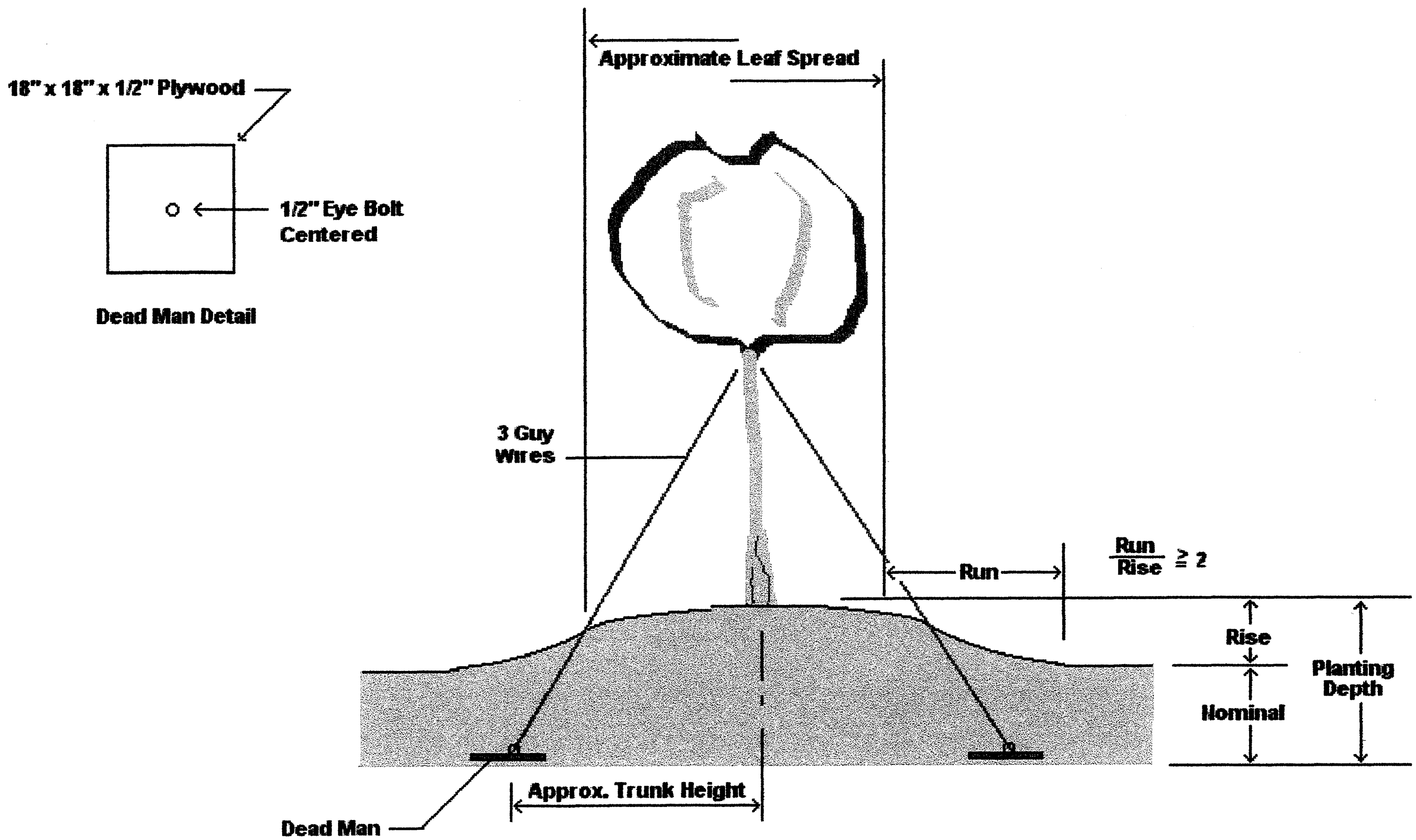
1.f Planting Details
Refer to **Drawing 1.2**. Soil mounding widths should equal the leaf spread of the mature plant as this width will also be about that of the root mat after the plant is established. To reduce mound erosion, the ratio of run to rise should be equal to or better than 2.

If guying is indicated, square plywood dead men can be buried directly in the soil at three equidistant points, at a distance from the center of the tree about equal to the clear trunk height of the tree. The plywood should be the least expensive lowest grade available. Avoid exterior, marine, FRT, Wolmanized and similar plywoods. It is desirable to let the plywood eventually decompose. By the time the guy wires need to be removed (about one year plus a growing season) the plywood should be sufficiently decomposed that the eye bolts will simply pull out, abandoning the remaining plywood. Galvanized ½" eye bolts will be sufficient. Use one nut, finger tight, to secure the eye bolt. Do not use washers. The guy wires and the eye bolts should be similar metals to prevent electrolytic corrosion. Use standard guying techniques otherwise.

END OF SECTION 1



BIG INDIAN RESORT & SPA	Dwg. No. 1.1
Title Soil Diagram	Date 8 Sept. 2001



BIG INDIAN RESORT & SPA

Dwg. No. **1.2**

Title: **Mounding Detail**

Date: **10 Sept 2001**

2. ROOF ASSEMBLY SUGGESTIONS

In addition to the normal weather protection function, the roof assembly for this project must satisfy the requirements of supporting a layer of soil medium sufficient for plant life as well as providing the means for positive water drainage and recovery of water, sediment and leachate.

The requirement of having soil on the exposed roof suggests a version of the Inverted Roof Membrane Assembly (IRMA roof). Originally developed to protect the waterproof barrier from mechanical and weather damage, this concept adapts readily to the proposed project.

Several manufacturers specialize in the materials for these systems, notably Dow Chemical (1), GAF, and Johns Manville among others. The IRMA roofing concept has been in practice for over two decades and is a proven system.

In the typical system, the waterproof membrane is adhered directly to the structural concrete substrate, covered with rigid insulation board, a filter fabric, and ballasted with crushed stone or concrete pavers. In this case, the ballast is the topsoil. See **Drawing 2.1**

The system also has the advantage of supporting pedestrian paver systems, (interlocking concrete tiles, for example) for the outside lounge and restaurant areas and the residence patios without modifying the basic roofing system, and this system offers a Class A fire rating as well.

The departure from using topsoil instead of conventional crushed stone as ballast will require some research and direct contact with the various IRMA manufacturers, particularly Johns Manville for their "Green Roof" products (See attached news item). The Green Roof concept however does not satisfy the positive drainage requirement.

If the roof insulation is placed under the soil layer as suggested, there is a possibility that it will absorb moisture over time and thereby reduce the desired R rating. To overcome this possibility, the insulation may be placed on the underside of the structural deck, and the drainage function provided by a layer of crushed stone. This approach is shown in **Drawing 2.2**.

Finally, some means should be provided to divert surface run-off from migrating onto the constructed portion of the roof in those areas where the constructed roof blends into the surrounding terrain. The hydrological gradient appears to fall to the east which allows the run-off from higher elevations to the west to drain onto the structure. The drawings are not sufficiently detailed at this point to show the intended method. Allowing surface run-off onto the roof will increase the possibility of flooding and may overcome the edge parapets and water collection and recovery provisions. Low-profile diversion berms and swales are a possibility.

2.1 Alternate 1.

Refer to the accompanying sketch, **Drawing 2.1**.

2.1.a. Membrane

The membrane most often used is a cold-applied, torch-applied, or hot mopped modified bitumen sheet (GAF Rubberoid Single Ply Membrane, for example) which is usually reinforced with fiberglass. The cold-applied membrane has an adhesive backing which is exposed by removing the paper backing as the sheet is unrolled. Once laid, the sheet is then rolled to ensure complete adhesion. The torch-applied membrane has a heat activated backing that is partially melted during installation by a special propane applicator. Hot-mopped membrane uses hot mopped asphalt (Type III) as an adhesive as in conventional multi-ply built-up roofs. Any of these methods would be suitable in this application and the selection most probably would be determined by local trade practices. To ensure proper quality control and to preserve the membrane manufacturers' warranties, only factory-licensed contractors should be considered.

2.1.b Insulation/Drainage Board

Insulation is provided by extruded foam boards (Dow Styrofoam, for example), usually 4' x 4' or 4' x 8' and with a thickness selected for the desired R rating. A thickness of 2" generally results in R-15. The board has grooves molded into the bottom surface which act as conduits to drain water along the slope of the base slab. The upper surface is smooth. The boards are loose-laid over the membrane with the butt edges fitted snugly. The system is constrained horizontally by the roof's normal curbs and parapets. Boards are easily cut for fitting less than full sheets and for odd fillers.

2.1.c Filter Fabric

Filter fabric is a porous nonwoven polymeric or polyester cloth (Phillips Fibers Corporation RUFON P3B or International Paper Confil 689H for example) which allows water to pass but prevents fine silt and other sediments from reaching the insulation board and eventually clogging the drainage system. The fabric is loose-laid although some applicators may use staples to hold the fabric in position while the ballast is placed. Sheets should be drawn tightly so that there are no folds or large wrinkles. Adjacent sheets should overlap by about 4". Edges at parapets and curbs should be turned up at least the thickness of the ballast and held in place by the ballast. After the ballast has been placed, excess fabric extending above the surface may be cut off.

2.1.d Ballast

In this application, the normally used crushed stone or concrete pavers is replaced by the topsoil which eventually receives the planting materials. Although part of the roof system, it is discussed in **Section 1, SOIL HANDLING & PLACEMENT.**

2.1.e Irrigation Tubing

Irrigation tubing is shown here for orientation purposes only. See **Section 4, IRRIGATION** for more detail.

2.2. Alternate 2

Refer to the accompanying sketch, **Drawing 2.2**

2.2.a. Membrane

Same as Alternate 1, Section 2.1.a.

2.2.b. Insulation/Drainage

In this alternate, insulation is mechanically fastened to the underside of the structural slab and drainage is accomplished by a layer of crushed stone, about 1-1/2" to 2" thick. Protection board is placed beneath the stone to prevent sharp stone edges from abrading the membrane.

2.2.c. Filter Fabric

Same as Alternate 1, Section 2.1.c.

2.2.d. Ballast

Same as Alternate 1, Section 2.1.d

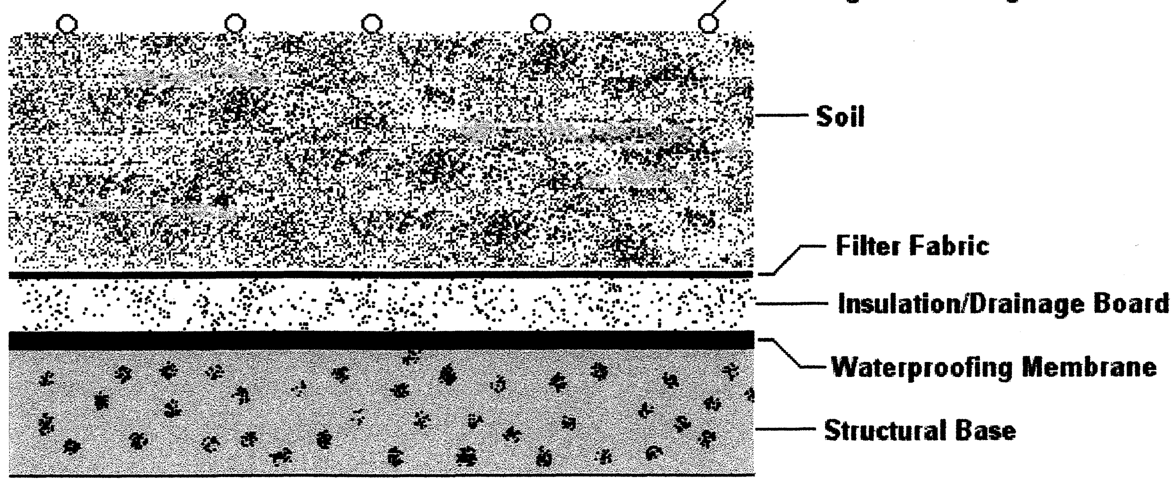
2.2.e. Irrigation Tubing

Same as Alternate 1, Section 2.1.e.

Note: Manufacturers and products are mentioned here only as illustrative examples and their mention does not constitute a construction specification or endorsement. The project architect should select final design and materials.

(1) Dow claims credit for inventing this system although it was actually developed in the 1970's by the U.S. Army's **Cold Regions Research Laboratory** in Nattick MA.

End of Section 2



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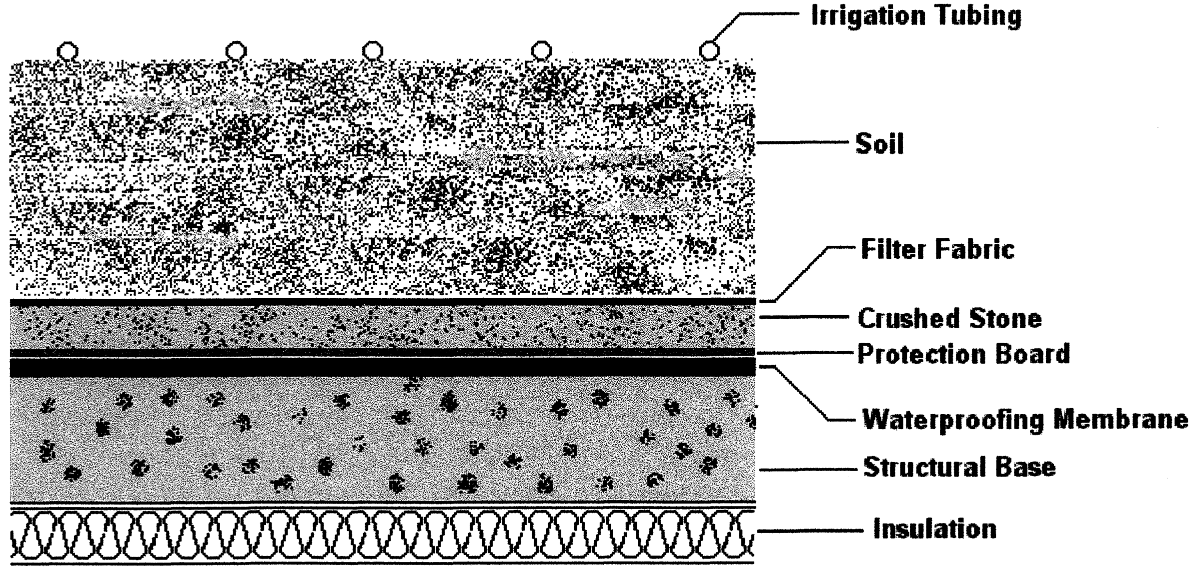
Title: Roof Section	Date: 4 August 2001



BIG INDIAN RESORT & SPA	Dwg. No. 2.2
Title: Roof Section	Date: 30 July 2001

Johns Manville
ROOFING SYSTEMS

Johns Manville Donates Roofing Membrane as Base Component for a Green Roof Application

Roofing membrane used on Earth Conservation Corps Center in Washington D.C.

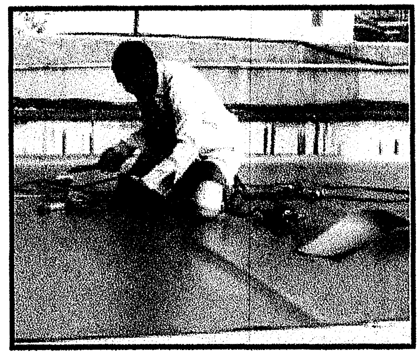
DENVER, CO (June 5, 2000) - The Roofing Systems Group of Johns Manville donated an UltraGard® SR-80 roofing membrane to serve as the base for a "**Green Roof**" application at the renovated Earth Conservation Corps Center (ECC Center) in Washington D.C. **Green Roof** technology is common in Europe but relatively new to the United States.

Extensive **Green Roof** technology involves putting a thin soil and vegetation layer over protection board applied to the waterproof membrane covering the entire roof surface. It offers reduction in storm water run-off and adds insulation value that improves energy performance of a building. It also moderates temperature extremes and avoids direct UV exposure of the roofing system.

"We are very pleased to be involved in furthering environmentally responsible roofing practices and helping a beneficial non-profit organization that is dedicated to youth development and environmental stewardship," said Joseph A. Stassi, single ply marketing manager for Johns Manville. "The timing of this donation is particularly significant for us since the UltraGard white PVC membrane recently received the ENERGY STAR® designation from the Environmental Protection Agency. Both the project and the designation reinforce our commitment to environmental stewardship."

In addition to the white PVC membrane that earned the EPA designation for its reflective properties, all PVC membranes can be used for **Green Roof** applications. The PVC membrane provides waterproofing and the protection board serves as a root-resistant barrier. The vegetation layer absorbs rainwater and helps to avoid unwanted heat gain from the roof surface.

The Earth Conservation Corps is a non-profit organization that works with disadvantaged youth to provide them with education and training by working on environmental restoration projects. The renovated Pumphouse will be the new ECC office and will share the space with D.C. Fisheries and Wildlife as well as the Anacostia and Potomac Riverkeepers.



The Pumphouse was built in 1906 to pump Anacostia River water to generate heat for the Capitol, House and Senate office buildings, and the Library of Congress building. Abandoned in the 1950's, the building is now leased from the city by ECC. This historic, two-story brick building stands on concrete pilings abandoned in one of the nation's most polluted rivers along the shore of Washington, D.C.'s most impoverished community. Current renovation projects will turn this landmark into a gathering place for the environmentally conscious from the local community.

A blue-chip volunteer team was assembled to assist with the roofing portion of the project. MAGCO was the roofing contractor and Olympic Fasteners donated the drains. Katrin Scholz-Barth, Director, Sustainable Design of the HOK Planning Group, with the leading architectural firm, HOK, coordinated the project and specified the Johns Manville membrane. Scholz-Barth, who is a native of Germany, has a great deal of experience with the **Green Roof** technology.

MAGCO Inc. is a wholly owned subsidiary of Tecta America Corporation and is one of the nations largest roofing contractors with sales in excess of $175 million.

"I selected the Johns Manville UltraGard membrane for this project because of my experience with **Green Roof** technology in Germany," Scholz-Barth said. "I felt very confident this membrane would work well in this application."

The roofing contractor, MAGCO Inc., donated their time and machinery to install the membrane. In selecting MAGCO for the project, Scholz-Barth heard nothing but praises about the company. According to Fred Kuntz of the International Monetary Fund, "MAGCO is the best roofing contractor I ever worked with." Mr. David Hawn, Dedicated Roof and Hydro-Solutions, also had high praise for MAGCO. "MAGCO stands out because of extra attention to detail that you don't get from a lot of other contractors," he said.

Johns Manville is a leading manufacturer and marketer of premium-quality building products. The 142-year-old Denver-based company had sales of $2.2 billion in 1999. Johns Manville employs approximately 9,700 people and operates 58 manufacturing facilities in North America, Europe and China. Additional information can be found at www.jm.com.

Search text: **green roofs**
Document 1 of 2
Title: **Johns Manville Donates Roofing Membrane as Base Component for a Green Roof Application**

Johns Manville

Commercial/Industrial Roofing Systems

SBS Modified Bitumen Specifications

7A.34 Asphalt Recommendations (PRMA)

7A.34.1 JM allows the use of only two grades of asphalt in SBS modified bitumen specifications -- Type III and Type IV. This recommendation also applies to PRMA specifications, in order to prevent adhesion of the extruded polystyrene insulation to the asphalt top pour.

7A.34.2 Ballast Requirements (for use with extruded polystyrene roof insulation):

7A.34.3 The ballast should be similar to ASTM D 448, Gradation #57. The following gradation is typical:

Passing 1/2" (13 mm)	10-60%
Passing 3/4" (19 mm)	100%

7A.34.4 Ballast is applied at a rate of approximately 10-12 lbs. per square foot (48.8-58.6 kg/m²) in the field of the roof over a layer of filter fabric. Twenty (20) lbs. per square foot (97.6 kg/m²) of ballast is required over a 4' (1.22 m) wide area at the roof perimeter and at all penetrations. The following fabrics have been found to be acceptable:

A. Confil 689H - 3.0 oz./yd. (93.5 g/m) black polyester from International Paper Company
B. Rufon P3B - 3.0 oz./yd. (93.5 g/m) black polypropylene from Phillips Fiber Corporation

7A.34.5 JM makes no claims as to the quality of these products nor their performance when exposed on the roof. See the product warranty supplied by the fabric manufacturer.

7A.34.6 When pavers are used as ballast, the pavers must be placed on supports or pedestals. These supports or pedestals can either be commercially available products or 6" (152 mm) square pieces of JM DynaTred Plus (to give a minimum 1/2" [13 mm] air space). These supports should be located at the intersection of the corners of the paver blocks, such that where the four corners come together, all rest on the same 6" (152 mm) square piece of DynaTred Plus or pedestal. The 1/2" (13 mm) air space between the pavers and the insulation will allow moisture vapor to vent to the atmosphere. If the moisture is not allowed to vent to the atmosphere, the top surface of the insulation will begin to absorb water and the thermal performance will be reduced. ROOF AREAS THAT HAVE PAVERS IN DIRECT CONTACT WITH THE INSULATION ARE EXCLUDED FROM COVERAGE UNDER A JM ROOFING SYSTEM GUARANTEE, INCLUDING

THE THERMAL OVERLAY PORTION OF THE GUARANTEE.

7A.34.7 The use of pavers in high traffic areas, to and around equipment and other maintenance areas, is strongly recommended.

7A.34.8 It is the owner's and/or specifier's responsibility to determine if the building structure can support the required amount of ballast and still meet the code design requirements for anticipated dead and live loads (including snow, wind, etc.).

Protected Roofing Membrane Assemblies (PRMA)

Decks (PRMA)

6-1998

HOME PRODUCTS CONTACT ABOUT CUSTOMER SERVICES

Ruberoid® Torch-Applied Modified Bitumen Membranes

- RUBEROID TORCH Membrane
- RUBEROID TORCH PLUS Membrane
- RUBEROID TORCH FR Membrane

Ruberoid torch-applied membranes are tough, resilient modified bitumen membranes manufactured to stringent GAF Materials Corporation specifications. Their core is a strong, resilient, non-woven polyester mat that is coated with weather resistant, polymer-modified asphalt. "FR"-designated membranes are coated with an inherently fire retardent polymer-modified asphalt. RUBEROID torch-applied membranes are designed for new roofing and reroofing applications as well as construction of flashings. They are also an ideal product for the repair of built-up roofing systems. Advantages include:

- **Cost effective** - the installed cost of RUBEROID torch-applied membranes is less than most single-ply systems on the market today.
- **Resilient** - special polyester mat core allows it to resist splits and tears due to its pliability and elongation characteristics.
- **Durable** - specially formulated APP-modified asphalt gives RUBEROID torch-applies membranes lastnig performance.
- **Backed by GAF Materials Corporation,** a company with over 100 years in the roofing business.

Return to the RUBEROID Modified Bitumen Roofing Membranes page

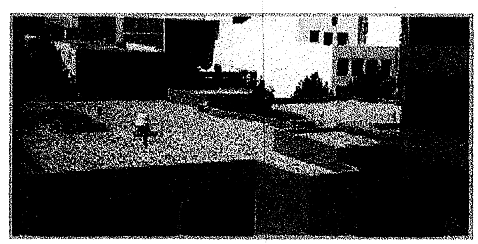
Styrofoam™ High Performance Insulation for Commercial/Industrial Construction

The **STYROFOAM** Product Range is a family of blue extruded polystyrene insulation boards, each designed for specific applications. The **STYROFOAM** Product Range allows greater design flexibility in the construction of roofs, walls and floors in both new building projects and renovations.

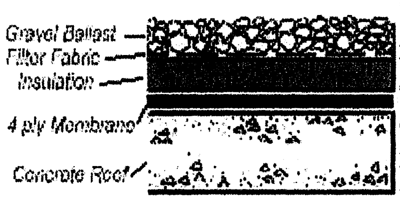
In many instances this flexibility brings key qualitative advantages, ease of application and cost savings when compared with traditional construction methods.

Dow developed the IRMA (Insulated Roof Membrane Assembly) System, and **STYROFOAM** is specified for long term performance in below roof or slab insulation. For tanking membrane protection where the insulation is buried **STYROFOAM**'s moisture resistance and long term compressive strength is fully utilised. In curtain wall construction **STYROFOAM** is used as a non slump waterproof insulation and in addition it has no OHS issues attached to its use.

The IRMA System

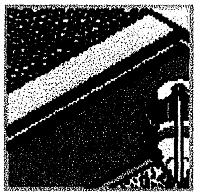


The IRMA (Insulated Roof Membrane Assembly) System is a roofing assembly that utilizes conventional roofing materials in a different and better way.



The insulating system comprises insulation laid on top of the roof membrane, a layer of water-permeable fabric and a covering of stone ballast which is used to prevent displacement of the insulation by wind or floatation. The result is a Class-A fire resistant wearing surface and the insulation being shielded from the ultra-violet light.

Variations to the IRMA roof system include the use of paving slabs, interlocking pavers, and concrete as ballast, to provide a trafficable deck for rooftop promenades, terraces, plazas and car parking areas.

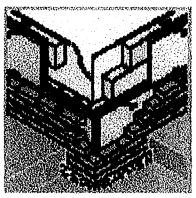


Insulation for Flat Roofs

STYROFOAM insulation products can be used in the most demanding situations, traditionally where the roof is ballasted with gravel or paving slabs. It has a rebated edge detail to ensure a continuous layer of insulation, and is available in a range of thicknesses to suit specific applications.
The use of **STYROFOAM** insulation in the upside down roof concept, in both new and existing buildings, is covered by ABSAC opinion #48.

Insulation for Pitched Roofs

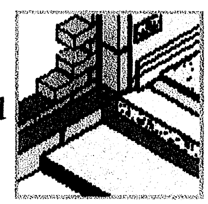
STYROFOAM products are suitable for use in pitched roofs of both new and existing buildings. It is available in a range of thicknesses, and has unique tongue and groove fit. The use of **STYROFOAM** means rafters stay condensation free, there is no need for roof-space ventilation and in alpine areas there is no need for lagging as pipes, tanks and allied services in the roof space are protected against freezing.



Insulation for Cavity Walls

STYROFOAM insulation boards can be fitted between wall ties. They keep their structural and thermal integrity even when buried, so they can be installed all the way down to the foundations, eliminating the risk of thermal bridging at ground level.
STYROFOAM is rugged, rigid and extremely resistant to the rigours of site conditions. The precision joint edge ensures efficient water-shedding and makes installation easy and precise. The low thermal conductivity means that R-values can be achieved even when plasterboard is used as the inner leaf.

Insulation for Floors



STYROFOAM has specifically designed floor insulation which is available in a range of grades to meet different load-bearing requirements. It can be placed directly above a suspended concrete slab, below a ground-bearing slab, above timber floors or below the joists.

PRODUCT APPLICATION GUIDE

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3. WATER BALANCE and RECOVERY

3.a General Considerations

In the discussions that follow, it should be noted that what is offered here is not exact science. Much of the data is empirical and dependent on conditions that may or may not exist in the present case or at any given time. Weather data for the site is sparse, dated and difficult to access. Quantitative data should be treated as "rule-of-thumb" with all the precautions that go along with that phrase.

The roof areas (total 240,123 s.f.) given on Drawing A-003, July 31, 2001 are assumed to be "wet" roof. That is, the total constructed area receiving direct rainfall, and thereby, the total area to be planted.

Water gain is provided by precipitation and irrigation. Water loss results from evaporation, drainage, and plant transpiration and guttation.

Transpiration is the evaporation of water from plant leaf surfaces and is the final step in the process by which plants obtain water and nutrients from the soil. Guttation (sweating) is the nocturnal loss of water, often mistaken for morning dew.

Water vapor emits from leaf structures called stomata which perform the same function as pores in the skin of mammals. Like pores, stomata can open or close, regulating the amount of water loss depending on environmental conditions such as temperature, wind, humidity, incident and reflected sunlight. Plants in general only retain about 10% of their water uptake.

The irrigation system is not a factor in the recovery system design as it should be active only during periods of insufficient precipitation.

Temperature data for the site indicates that from approximately October through April most plants will be dormant and will require only sufficient moisture to prevent excessive dessication ("winter burn"). It appears that precipitation during the dormant period will be sufficient for that purpose.

3.b Water Gain

One inch of continuous precipitation deposits approximately 0.6 gallons of water per square foot of soil surface. The soil structure (ratio of sand/silt/clay) will determine how much of that water is retained and how much will need to be drained off the structure. A nominal 12" thick layer of common topsoil that falls within the "loam" envelope (**Drawing 1.1**) of the soil structure diagram will retain most normal precipitation events.

Data from the nearest weather reporting station(1) is not as complete as would be desired(2). There are 569 observations out of a possible 3,700, or a sample of only about 15%. Better and more recent data may be obtainable from local conservation officials, an Agricultural Extension or the weather records of local media.

Nevertheless, precipitation averages in excess of 60" per year with the peaks occurring during April and August and the lows from December to March. Not accidently, these periods coincide respectively with the highest and lowest rates of plant growth, flowering and fruiting, and consequently the corresponding amount of water needed to sustain them.

From the available data (569 days) , the 24-hour total frequencies over a ten-year period are:

253 Days 0" to 0.1"
316 Days in excess of 0.1"
112 Days in excess of 0.5"
48 Days in excess of 1"
14 Days in excess of 2"
4 Days in excess of 3"
2 Days in excess of 4" (8/9/65 and 4/25/68)

The soil and water characteristics discussed in the following now assume that light-weight soil is being used. See **Section 1, Soil Handling & Placement** for soil amendment recommendations.

The roof area is noted to be 240,123 s.f. Each inch of precipitation (0.62 gallons per square foot) then would deposit about 148,000 gallons of water on the roof. Amended soil will retain about 2 gallons per cubic foot from its dry state, or the equivalent of approximately 3" of precipitation if the soil layer averages 12" thick. To the extent that the data records are representative, the soil layer will retain most precipitation events, experiencing run-off on those days when a single precipitation event exceeds 3" or if precipitation occurs when the soil layer is already partly or completely saturated. This will be an entirely random combination of circumstances and impossible to quantify.

As an example, if it assumed that the precipitation frequency is such that the soil is always about 30% saturated, then precipitation events in excess of 2" will result in run-off. According to the data, this has occurred in 14 out of 569 days or about nine times per year.

3.c Water Loss

The three common causes of water loss will be evaporation, drainage, and plant activity.

Water loss to the system occurs primarily by evaporation from the soil surface and, to a lesser extent, gravity drainage into the subsoil . The evaporation rate of loss is determined by soil temperature, air temperature, wind, relative humidity, incident sunlight, and how much soil moisture is present, but a worst case figure of about 1,500 gallons per acre per day can be used for bare soil. In general, soils will lose about 3% of their remaining water per day to evaporation for as long as there is no further precipitation. Note that the process is nonlinear. Surface loss by evaporation can be reduced significantly by mulching. See **Section *i*** for a discussion of mulching.

Using the evaporation figure of 1,500 gallons per day, maxumum water loss to the roof system would be 8,300 gallons daily, or the equivalent of about 0.056" daily precipitation, an event that can be expected historically to occur about 200 days of the year. Use of mulch and precipitation events in excess of the example indicate that the water balance of the system will be mostly positive for most of the year. Data available does not permit drawing any finer point than this.

The amendment suggested for the light weight soil has a water retention factor in excess of 50% by weight, so drainage by gravity will be less than in unamended soils (retention of 40% to 45%) and is not considered to be a significant factor in these estimates.

The second most significant cause of water loss is plant transpiration. Transpiration rates depend on the type and mix of plants selected and their response to light, temperature, soil moisture, humidity and wind. There are too many interdependent variables for transpiration to be treated quantitatively. Irrigation rates are determined by soil monitoring, or empirically by observation and experience when the entire system including plants and mulching are in place.

3.d Recovery

As noted above, the soil layer will retain most precipitation events. The water recovery system will have to handle water from two sources however, depending of circumstances noted as follows:

-- **Gravity Drainage.** Water will continuously drain from the soil layer into the drainage blanket by gravity. The amount and rate will depend on the soil structure, soil amendments, and the amount of water being retained. Like evaporation, this is a nonlinear process. **Section 2** discusses a drainage structure below the soil layer. The purpose of this structure is to simulate the natural soil subsurface which allows gravity drainage of water from the upper topsoil layer. Without this drainage, water trapped in the soil layer above will cause root rot in the plants, promote the growth of mold, and provide conditions for anaerobic decay. Subsoil paths must be provided to the roof leader points, the location of which are determined by the pitch of the structural slab below.

-- **Run-Off.** In order to prevent or reduce ponding on the soil surface or uncontrolled run-off over parapets, means must also be provided to capture surface runoff for those times when precipitation rates exceed the ability of the soil to absorb any more water. Refer to **Drawing 3.1**. Roof scupper, bell housing and gravel basket are the same as in any conventional roof design. Extending through the soil is a PVC tube, slotted and screened at the bottom to receive drainage blanket water, and open at the top to receive surface run-off. The filter fabric blanket is turned up at the tube and fastened with a nylon strap. A debris screen prevents plant droppings from entering the drainage system. The tube also provides a means to inspect and maintain the scuppers and gravel baskets. Soil surface low points should correspond generally to roof leader locations. A 6" or 8" diameter PVC DWV pipe, cut to the necessary length, is proposed for the tube. A metal or concrete structure would be more durable but more expensive also.

The scuppers and leaders need to be heat traced to prevent ice dams and insulated to prevent condensation tempered spaces.

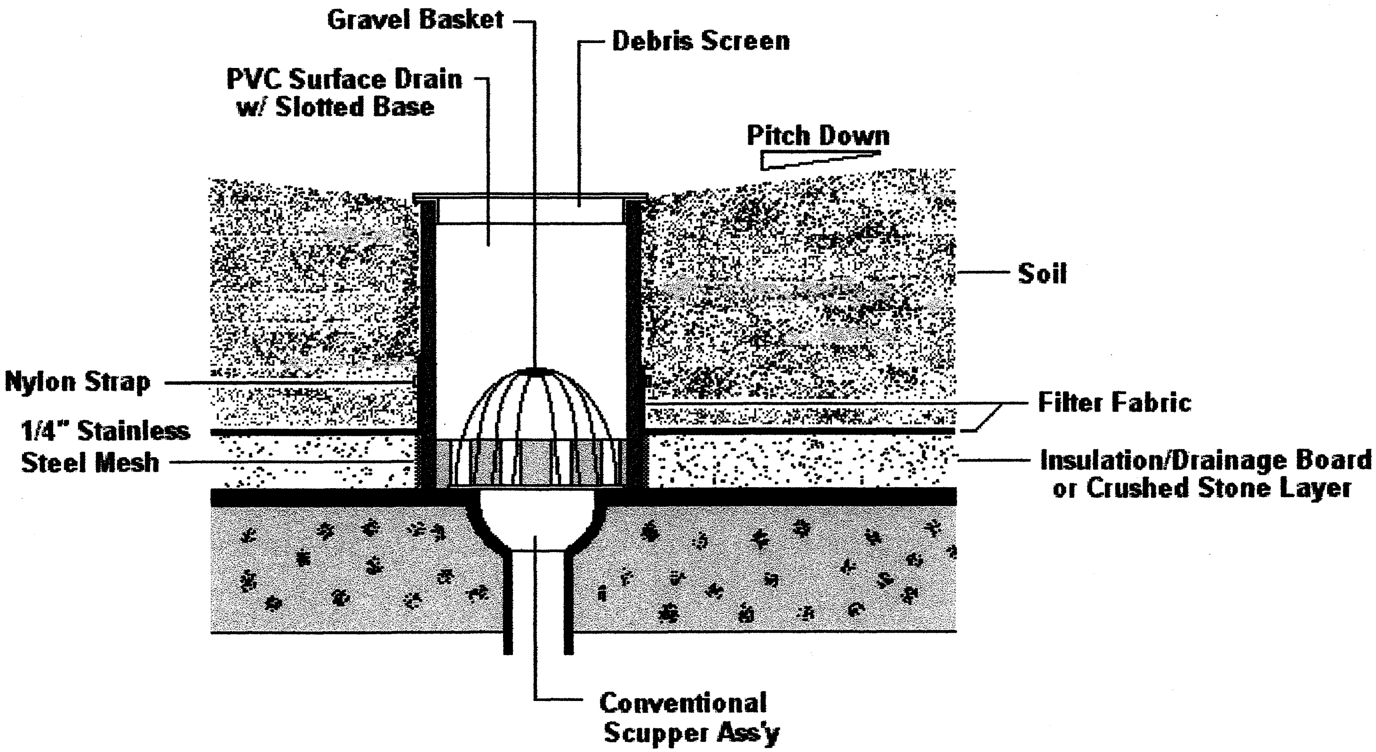
Project correspondence makes note of one or more holding (golf) ponds with a capacity of seven million gallons although these structures are not noted on the drawings in hand. Roof water and leachate recovery will require that the roof water collection system eventually drain into a holding structure of some sort and one or more of these ponds would be useful if located below the lowest roof level and within reasonable piping distance. Leachate dilution will be a function of holding structure capacity and the ratios of water received from other sources which can only be quantified when the topography surrounding the pond(s) is known. (See **Section 5, Fertilization Regimen and Recommendations** for leachate calculations).

In general, it has been shown that the storm water system for this project should be designed as though there is no intervening soil layer. In this way, the recovery system will be able to handle periods of excess precipitation while the soil layer will be left to absorb and retain as much water as its condition will allow at the time. The interaction of the soil layer in this process will be to reduce the amount of precipitation that needs to be handled, and to slow the rate of precipitation release into the recovery system.

(1) Slide Mountain, NNDC Station Number 307799

(2) The data file is available only in electronic media. The file name is 698944193644dat.txt, size 599kb, ASCI format, comma (hex[2Ch]) delimited. Records are sequential, length is 1,050 characters. Like data elements are not always in the same location from record to record. At least five different record formats were detected. The record length prevents the file from being read by most software programs. There is no end-of-file marker.

END OF SECTION 3



BIG INDIAN RESORT & SPA	Dwg. No. 3.1
Title Roof Drain Detail	Date 22 August '01

4. IRRIGATION

4.a General Considerations

A drip system is proposed for several reasons. Drip systems have less evaporative loss than sprays, are not as effected by windy conditions, and there is a low likelihood that guests will be inconvenienced during irrigation cycles. Secondarily, maintenance is lower, operations are simpler, and the system is generally less intrusive on the landscape scene.

This will be a quite large irrigation system by any measure, including those of large commercial nurseries. While irrigation design is not a complicated process, the size and configuration of this project requires some special considerations. Although this system will be unique in several respects, it can nevertheless be constructed with readily available components.

The following assumes that the primary water source will be the golf course holding pond(s). It is also assumed that the discharge of the golf course irrigation pumps will not be available to this system. These pumps probably will operate at pressures that are incompatible with drip systems, and their time cycles probably will not coincide with optimum plant irrigation times. Irrigation pumps are not expensive and so multiple pumping stations are contemplated. Pump sets are usually dual voltage (208/115 v). Operation at 208 v. is recommended.

N.B. There is no current standardization among drip system manufacturers. For example, the ½" drip tubing from Netafim will not properly fit the ½" drip fittings from Rainbird. It is important, when ordering or specifying drip system components, that the tubing and its fittings be obtained from the same manufacturer.

Even with the correct fittings, the drip tubing will, over time, loosen its grip on the fittings and so supplementary clamps are recommended (Oetiker #210 stainless steel cinch bands, for example).

A water meter at each pumping station is recommended. The flow volume is recorded for each zone at the time the system is commissioned and then periodically thereafter. An unexplained increase or decrease in zone volume is an indication of trouble in the zone, a separated fitting for example or a crimped tube.

4.b System Parameters

The irrigation system is divided into zones, each with its own remotely controlled valve connected to a central controller. Separate zones served by the same pumping station operate sequentially so that demand does not exceed pump capacity. See **Drawing 4.1** for a general layout of one pump station. See **Paragraph 4.g** for an annotation of the pump station components.

The drip emitters are pressure compensated so that they deliver constant rated output at pressures between about 10 psi and 50 psi. System pressures above about 60 psi can damage the drip tube connections and must be avoided. The recommended emitters are also self-flushing so that the chance of clogging is minimized.

In-line drip tubing is recommended. In this product, the drip emitters are internal to the tubing, being installed at the time the tubing is manufactured. This system is easily installed, labor is lower than with inserted emitter systems, and the emitters are less susceptible to damage from external causes..

An irrigated area of approximately 240,000 s.f. is used as the basic design parameter. Each drip line is sized to meet an assumed pumping capacity of about 40 gallons per minute (gpm) which is just under the capacity of most commonly available irrigation pumps. Common pumps are recommended as they are inexpensive, easily repaired or replaced, and parts are readily available.

The recommended drip line has 0.6 gallon per hour (gph) emitters at 24" spacing, or 0.3 gph per linear foot. A 40 gpm pump (2,400 gph) therefore will serve a drip line network with 8,000 linear feet of tubing.

To irrigate an area, adjacent lines are spaced apart the same distance as the emitter spacing, or 24". Therefore the line, one zone, will serve a maximum of about 4,000 s.f. of roof area. The system in its entirety will require at least 60 zones.

The most commonly available irrigation controllers have only 20 zones. Rainbird ESP-LX Plus would be an appropriate selection here. Therefore the outside parameters would appear to require a minimum of three separate controllers. Note that a controller may operate control valves in more then one pumping station. See **Drawing 4.5** for a typical controller installation. Note the location of the Rain Sensor. This device interrupts the common wire when it senses water in its collecting pan and prevents the irrigation system from operating during precipitation.

4.c General Configuration

It is assumed that each floor of the building will have one or more core risers that will be available for irrigation piping, and that each floor also will have one or more tempered utility spaces that can accommodate a floor mounted pump and pressure tank, and a wall mounted controller. Approximately 12 s.f. of floor space will be needed for each pumping station including its piping and valving.

Primary irrigation water of at least atmospheric pressure will have to be delivered to each pumping station through the building's utility cores. Ideally this would be available from the pressurized side of the golf course irrigation system, otherwise a separate booster pump will be required to draw water from the holding pond(s). The design of the primary water system is left to the mechanical engineer in that there is no information at this time regarding the golf course irrigation design.

Each utility space containing a pumping station will also require a 110 v. convenience outlet for the controller, a circuit with manual disconnect capable of supplying a half horsepower motor-pump set at 208 volts, sleeving for 1-1/4" inlet piping, 1" discharge piping, and a 1/2" sleeve for the wiring to the remote control valves. Sleeving for roof penetrations is also required. See **Drawing 4.2** for typical details.

If the utility rooms are adjacent to guest rooms, the motor-pump set should be vibration isolated.

4.d Pump Stations

Roof areas are combined in some cases to offer zones of approximately equal size, with pumping stations serving the floor on which they are located, and areas of the floor below in order to reduce pump head. Roof areas are noted as follows:

Elevation	Floor	Wet Area	Zones	Half Zones
2425	Roof	53,313	13	7
2410	Lobby	39,793	10	5
2395	4th Floor	19,715	5	3
2380	3rd Floor	72,345	18	9
2365	2nd Floor	16,033	4	2
2350	1st Floor	38,924	10	n/a

Two pumping stations on the lobby level will each serve half of the roof, lobby, and 4th floor roofs. Two pumping stations on the 3rd floor will each serve half the 3rd and 2nd floor roofs, and one pumping station on the 1st floor will serve the 1st floor roof for a total of five stations.. The configuration of the first floor roof requires that it have its own pumping station although its size would not ordinarily require this. Actual pump station locations will have to be coordinated with the architect and may require reconfiguring to accommodate building features.

4.e Drip Configuration

It should be noted at the outset that drip systems are intended only to keep the soil moist beneath whatever mulching is used. It is not necessary nor intended that each and every plant have its own drip emitter. Drip tubes are laid out to provide an approximately even coverage of the area to be irrigated.

In this system, 0.6 gph (2 liters per hour) emitters spaced at 24" are recommended. Tube lines are laid parallel to each other, the about the same distance apart as the emitter spacing (24") with the emitters approximately staggered in adjacent lines. See **Drawing 4.3** for a typical layout.

In the event that a specific plant requires direct irrigation, a 1/4" barb coupler is inserted into the nearest drip tube and a 1/4" (microtube) line is run to the plant, connecting to one or more separate emitters at the base of the plant. See also **Drawing 4.3.** The individual emitters are recommended to be 1 gph. This treatment is reserved for plants whose irrigation needs are atypical to the others in the same irrigation zone.

4.f Fertigation
Fertigation is the process of simultaneously fertilizing and irrigating using the basic irrigation system for delivery. A plantable area of this size makes a system like this the only practical way to apply chemical treatments.

As noted in the fertilizer section that follows, a system is proposed here that injects fertilizer, and systemic insecticides and fungicides directly into the irrigation stream. The system recommended operates by water-driven motor and is not dependent on venturi suction. Venturi type injectors can complicate design and operation of the system and should be avoided. This system is commonly used in large nurseries and many products are available, both injectors and chemicals, that are designed for this purpose. See **Drawing 4.4** for a typical fertigator layout. A Dosmatic A3 or A10 injector would be typical. This injector offers an adjustable dilution ratio that can be as high as 500:1. A 500:1 dilution ratio permits the use of liquid fertilizers directly from the drum without the need for further dilution.

An optional secondary bypass can be used if higher dilution ratios are desired. The pipe size is usually half or less than that of the main lines. The volume control valve is adjusted for the desired additional dilution and the secondary bypass valve is used to turn on or off the secondary bypass without disturbing the volume control setting.

Note that the fertigator component is only used when chemical injection is desired. Otherwise the surrounding valving system bypasses the fertigator and only water is delivered. This is the normal operating mode.

A fertigator should be located at each pumping station and connected in line with the pump discharge.

4.f Pump Drawing Annotation
Refer to **Drawing 4.1** for the following discussion. Special components and their requirements are noted below:

<u>Strainer</u> - Unless a strainer is present in the upstream system, one will be required here to remove gross debris drawn from the holding ponds and to prevent unnecessary loading of the filters.

<u>Pump</u> - Close-coupled "shallow well" type motor/pump set. One-half horsepower, 208 v. with a capacity of about 45 gpm at zero head. Meyers HR or equal.

<u>Pressure Switch</u> - Usually supplied with and mounted on the pump set. Cut-on pressure should not be less that 35 psi. Cut-off pressure should not be more than 55 psi.

Pressure Gauge - Water pressure gauge with a scale of 0 to 100 psi. Used to calibrate the pressure switch.

Water Meter - For periodic monitoring of water volume by zone. A trouble-shooting device.

Filter - Used to prevent clogging of the drip emitters. Minimum 200 mesh with internal flush and removable filter cartridge features.

Master Control Valve - A redundant valve to ensure that the system is closed even though one of the remote valves may fail or be leaking through. Connected to a special terminal (marked MV) in the controller.

Blowdown - A port used during winterization to flush the drip system of water. Uses a low pressure, high volume blower usually provided by the winterization contractor. Its position in this diagram assumes the pumping station is in tempered space. Consult with local irrigation contractors regarding type and size of fitting they require.

Pressure Tank - A precharged, vertical tank. Some have motor mounts already installed for mounting the motor/pump set. Recommend 50 gallon capacity.

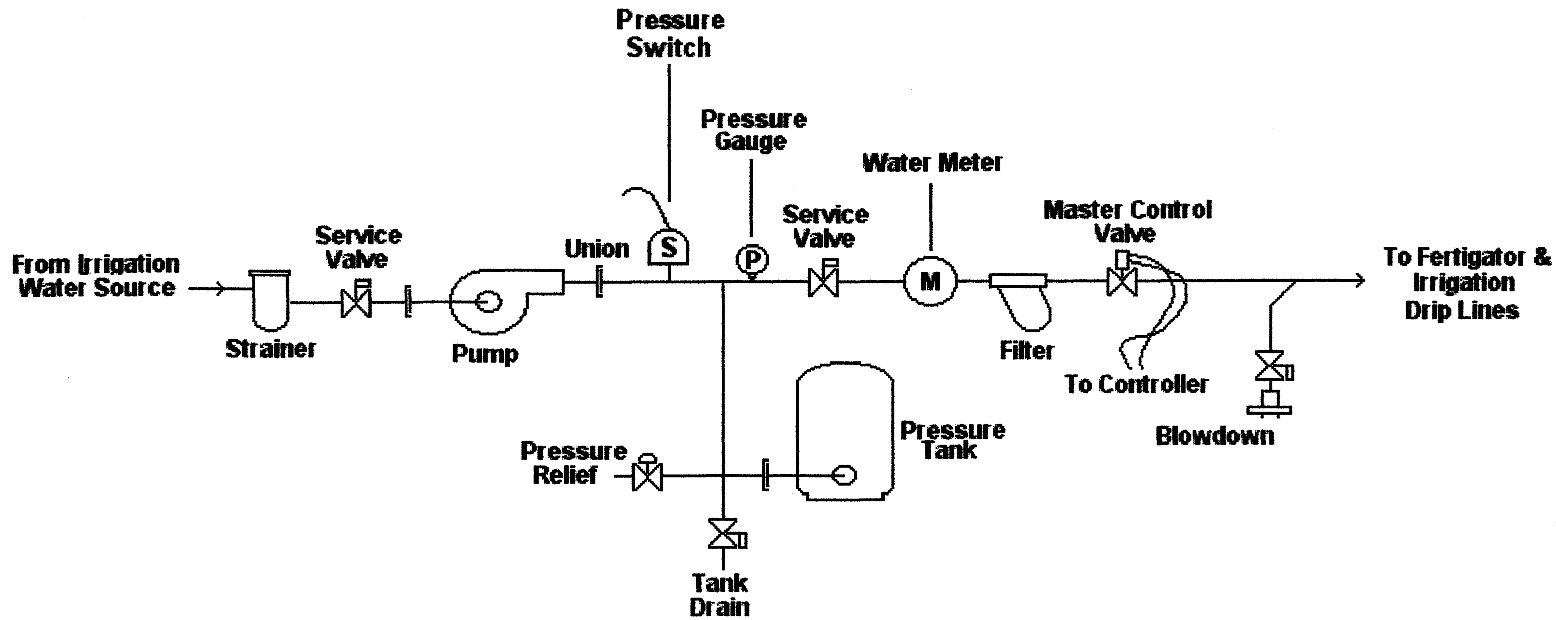
Pressure Relief Valve - Usually required by the tank manufacturer and or local codes. Set at tank manufacturer's recommendations but no more than 60 psi. Pressures above 60 psi will damage drip fittings and blow apart tube couplings.

Tank Drain - A common boiler drain cock.

Piping and Fittings in General - Schedule 40 PVC with solvent couplings.

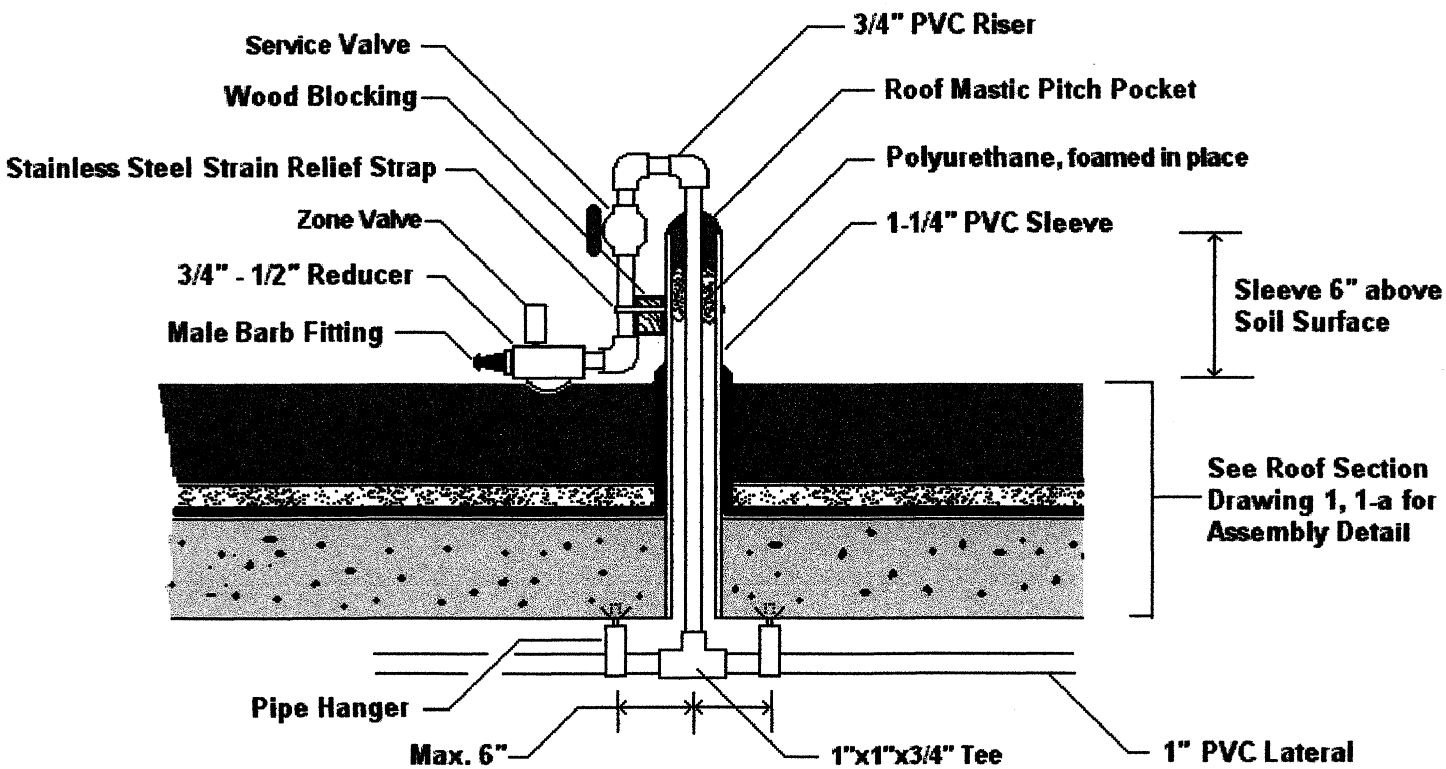
Service Valves - Common PVC ball valves.

End of Section 4

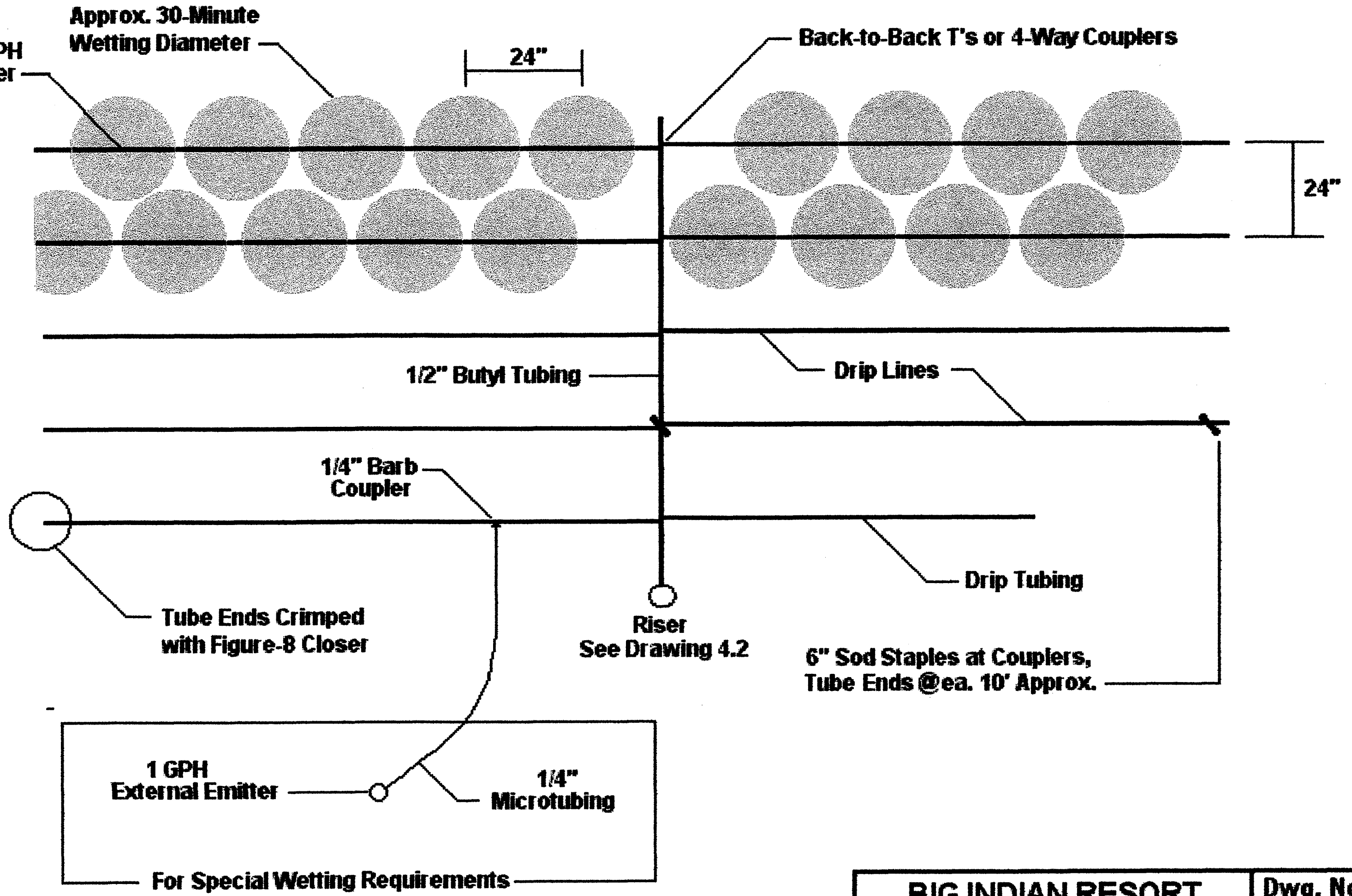


BIG INDIAN RESORT & SPA	Dwg. No. 4.1
Title: Typical Pump Station	Date: 7 July 2001

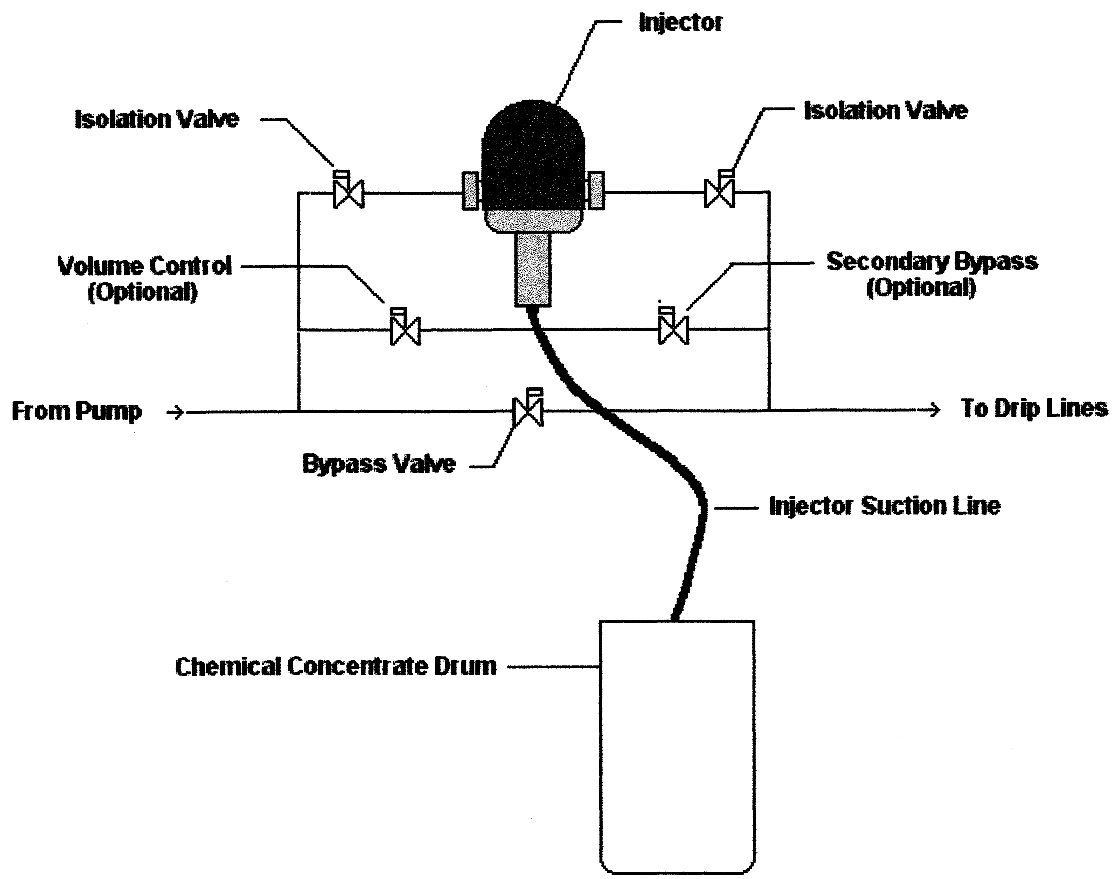
Note: Paint all above-roof exposed fittings non-reflective black



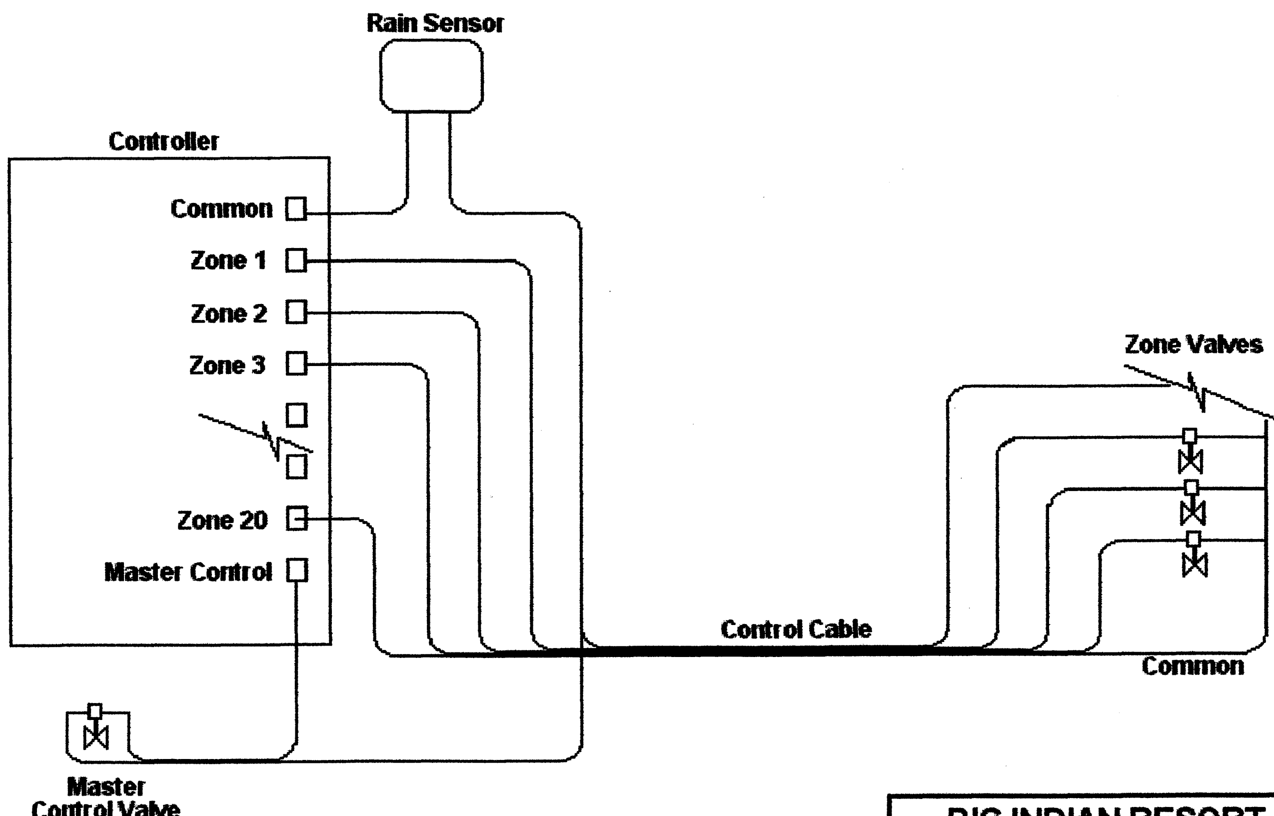
BIG INDIAN RESORT & SPA	Dwg. No. 4.2
Title: Roof Penetration Detail	Date: 7 July 2001



BIG INDIAN RESORT & SPA	Dwg. No. 4.3
Title: Typical Drip Tube Layout	Date: 7 July 2001



BIG INDIAN RESORT & SPA	Dwg. No. 4.4
Title: Typical Fertigator	Date: Nov. 18, 2001



BIG INDIAN RESORT & SPA	Dwg. No. 4.5
Title Controller Installation	Date Nov. 18, 2001

5. FERTILIZER REGIMEN and RECOMMENDATIONS

5.a General Considerations

A nutrient analysis of the imported soil is not available at the time this section was prepared so the information following is necessarily general in nature.

Plants live in a largely self-contained ecosystem. Nutrients are drawn from the soil, and the plant uses them to produce leaves, flowers, fruit and seed. Eventually most of this growth is dropped by the plant where it decomposes by bacterial action, and in time the nutrients thereby returned to the soil. The portion of the nutrients lost to the cycle are those retained by the plant to produce permanent growth of trunk and branch, usually the woody parts, the parts of the plant that are carried off by birds and other animals and the nutrients lost to leaching by rain and irrigation water. It is these portion that must be replaced in the soil from time to time if growth and health are to be sustained.

Heavy fertilization is needed mostly in crop farming where some part or all of the plant is removed from the ecosystem by harvesting. Soil nutrients become depleted or unbalanced quickly, and this must be corrected artificially if another crop is to be grown. This will not be the case here.

Fertilizer design for this project should meet these objectives:

> Sustain healthy plants so that they are less susceptible to insect and disease,
>
> Limit fertilization quantities to those amounts that have been permanently removed,
>
> Limit fertilizer quantities to prevent rampant growth and to avoid excess pruning,
>
> Reduce or prevent fertilizer leachate, particularly phosphates, from leaving the system.

Reducing phosphate use not only has the main benefit of reducing harmful leachate, but excessive phosphates are known to inhibit root development also.

Plant nutritional needs will differ according to the season, the plant species, and the life cycle of the species. Plant selection should take into consideration those species with similar nutritional (and irrigation) needs if they are to be supported by the same horticultural system.

Best practice dictates that soil samples be taken and analyzed about every three years or so, so that the fertilizer formula can be adjusted if necessary.

5.b Application
The plantable area of this project will make hand application of fertilizer impractical, and the physical parameters prevent machine application. For these and other reasons, a system is proposed whereby fertilizer is automatically injected into the irrigation stream so that plants are watered and fertilized at the same time; a process sometimes referred to as "fertigation."

The prior **Section 4, Irrigation** describes a fertilizer injection system that is recommended here. This system requires a liquid or water soluble fertilizer and many fertilizer types are manufactured for this purpose as this method is commonly used in large commercial nurseries. Two of the most widely used product lines are manufactured by ProSol and Solufeed (See attached). Of these, a premixed liquid concentrate is preferred. A water soluble product must be mixed with water before use, and the quantities required in this application would make the mixing of dry products a major undertaking.

Fertilizer concentrate is held in drums, usually at the pumping station inside the hotel, and drawn into the irrigation stream during those irrigation cycles when fertilization is desired. Otherwise, the injectors are bypassed and only water is supplied.

The injection mechanism automatically apportions the ratio of water to fertilizer. In some systems the ratios are adjustable to meet differing crop needs. By selecting the correct injector ratio, it can be possible to use the concentrate directly as it comes from the manufacturer and still have the correct dilution ratio at the point of delivery.

5.c Frequency
An initial fertilizer dose should be applied at the time of planting. This application will help the plant recover from transplant shock, adapt to a new microclimate, and promote early root growth so as to establish the plant as soon as possible. A slow release tablet form is recommended. Some example products are Agriform and Plantabs although many products are available. The fertilizer is in pellet form and simply dropped into the planting hole at the time the plants are installed. The number of pellets per plant depends only on plant size at the time of planting and is specified on the manufacturer's label.

After planting, plants should be allowed to go through one full growing season before applying fertilizer again. Thereafter, fertilizer applications are recommended only twice per year in this system: Once in the spring when new growth is observed on most of the specimens; and once in midsummer to replace permanently removed nutrients and those lost to leaching by rainfall and irrigation.

It is important to accurately observe the extent of new growth for the spring application. Premature application, when most of the plants are still dormant, will not be taken up when needed most.

Fertilization in midsummer provides a sustaining feeding but should not be applied later than around the end of June because late fertilizer application will prompt tender growth that will be killed or damaged in the first frost. Also, late application will leave more residual fertilizer which will find its way into the leachate over the winter.

5.d Dosage

In the absence of a soil nutrient analysis, the only recommendation that can be made at this time is to use a balanced fertilizer such as 8-8-8 or 10-10-10. A general application of 8-8-8 concentrate requires a dilution of about one gallon of concentrate per 400 gallons of water which is sufficient for about 1,600 sq.ft. of plantable area.

Using an injector with a dilution ratio of 400:1 would permit direct use of the concentrate, thereby eliminating the need to dilute the concentrate on site and also eliminating the need for mixing drums and the space they would take up. One application in this system would require about 150 gallons of concentrate. At current retail price, one fertilizer application would cost approximately $2,400.

The midsummer application should be at about half the manufacturer's recommendation, or 75 gallons of concentrate assuming the injection ratio is still 400:1.

When the specified amount of concentrate has been used, the fertilizer application is complete for that cycle, and the injector assembly is valved out of the system until the next application.

5.e Leachate

Using the above example, the phosphate provided to the plant areas would be about 141 lbs in the spring feeding, and about 70 lbs in the midsummer feeding, or about 210 lbs of phosphate annually. As worst case, if the entire amount of phosphate went to leachate and the leachate drained completely into the holding pond, the pond's phosphate concentration would be elevated by about 2.6 parts per million (ppm).

This concentration would be reduced by the amount of fertilizer taken up by the plants and that retained by the soil. If the holding pond is used for other purposes such as golf course irrigation, the phosphate concentration would be further reduced by depletion to the golf course and subsequent dilution by run-off from the terrain surrounding the pond.

Depending on the actual soil analysis, a sufficient application of phosphate may be higher or lower than the foregoing example. A reasonable margin would be from 50% lower to 100% higher.

End of Section 5

Agricultural | Turf/Lawn Care | Horticulture | Consumer Products

- New Products
- Frit UK Ltd
- Quality Control
- Salesman List
- The Weather Channel

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