

PACKAGE- 7A

**TENDER FOR HORTICULTURE WORKS FOR EAST PART OF PROPOSED
PERMANENT CAMPUS (PHASE I) FOR**

NALANDA UNIVERSITY, AT RAJGIR, BIHAR.



TECHNICAL SPECIFICATIONS

NALANDA UNIVERSITY, RAJGIR, BIHAR.

Every care has been taken while preparing this document to cover all necessary information, matters, specifications, general conditions, special conditions & provisions for smooth and complete execution of works. However, in case of any omission in the tender/ contract document, the most recent version of correction slips (as on 14th June 2018) of TECHNICAL SPECIFICATIONS FOR HORTICULTURE WORK shall be the reference manual.

DEVELOPMENT OF PERMANENT CAMPUS (PHASE-I) FOR NALANDA UNIVERSITY

Supplying and stacking of good earth at site (earth measured in stacks will be reduced by 20% for payment). Good earth shall consist of a free draining organic soil from horizons less than 300mm from the original surface, of a workable crumbly and lump free loamy character and shall contain no grass or weed growth of any kind or other foreign material or stones exceeding 25mm in diameter. Total stone content shall be no greater than 5% by volume. A 1 litre sample with back up soil test data is required before supply, to be approved by EIC. Soil should conform to the following parameters: pH 5.5 - 7.8, Electrical conductivity 1:2.5 (w/v), Soil-water extract not exceeding 1500 micromho/cm, Soil texture Sand (0.05 - 2.00mm) Max. 75% Min. 20%, Silt (0.002 - 0.05mm) Max. 60% Min. 5%, Clay (less than 0.002mm) Max. 30% Min. 5%. Item includes all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required for supply and stacking of good earth.

Good earth shall consist of a free draining organic soil from horizons less than 300mm from the original surface, of a workable crumbly and lump free loamy character and shall contain no grass or weed growth of any kind or other foreign material or stones exceeding 25mm in diameter. Total stone content shall be no greater than 15% by volume. A 1 litre sample with back up soil test data is required before installation, or mixing.

The following criteria shall be tested at an approved laboratory before use on site

pH 5.5 - 7.8

Electrical conductivity (1:2.5 (w/v) Soil-water extract) not exceeding 1500 micromho/cm

Soil texture

Sand (0.05 - 2.00mm) Max. 75% Min. 20%

Silt (0.002 - 0.05mm) Max. 60% Min. 5%

Clay (less than 0.002mm) Max. 30% Min. 5%

The earth shall be stacked at site in stacks not less than 50 cm high and of volume not less than 3.0 cum.

Measurements:

Length, breadth and height of stacks shall be measured correct to a cm. The volume of the stacks shall be reduced by 20% for voids before payment, unless otherwise described. The rate shall include the cost of excavating the earth from areas lying at distance not exceeding one km. from the site, transporting the same at site breaking of clods and stacking at places indicated. The rate shall also include royalty if payable. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Supplying and stacking of well decayed cow dung manure (cattle manure measured in stacks will be reduced by 8% for Payment). Manure shall be well composted, dried, well screened good quality in powdered form. Manure, shall be free from soil clods, fresh mung grass, and dry. Sample will be approved by EIC. Item includes all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required for supply and stacking of good earth.

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Contractor shall supply only well composted, dried, well screened good quality Farm Yard Manure in powdered form. Farm Yard Manure, shall be free from soil clods, fresh mung grass, and dry. Sample will be approved by Landscape Architects.

The following criteria shall be tested at an approved laboratory before use on site

pH 5.5 - 7.8

Electrical conductivity (1:2.5 (w/v) Soil-water extract) not exceeding 1500 micromho/cm

It shall be transported to the site in lorries with efficient arrangement to prevent spilling enroute. It shall be stacked at site. Each stack shall not be less than 50 cm height and volume not less than 3 cum.

Measurements

Length, breadth and depth of stacks shall be measured correct to a cm. The volume of the stack shall be reduced by 8% for looseness in stacking and to arrive at the net quantity for payment. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Complete maintenance of the plantation area i.e. lawn trees, shrubs, hedge, flower beds, foliages, creepers etc. including hoeing, weeding pruning replacement of plants, gap filling, watering, mowing of lawn, grass cutting by lawn mover and brush cutter , removal of garden waste, applying insecticide, pesticide & fertilizers (whenever required) top dressing of lawn with good earth and manure and maintenance of other garden related works as directed by EIC (Cost of Good Earth, Manure, Fertilizer, Insecticide , Pesticide, will be provided by the Institution & other T & P material/articles shall be provided by the contractor, as per yard stick 1Mali per acre (5 years)

The Contractor shall water all trees, palms, shrubs, ground cover, rooted shoots, herbaceous plants and other planting areas as often as necessary to keep the ground moist all around and to the full depth of the roots of the plants to a minimum depth of saturation of:

100mm for groundcover

300mm for shrubs

750mm for trees

Fresh water only shall be used for the landscape. Water shall be supplied to the Contractor from agreed points on the site. However, it will be only to necessary for the Contractor to supply his own means of transport from the watering points to the plant beds. An inspection of watering requirements is to be made by the Contractor at least two times a week in dry weather.

Water shall be supplied using an approved hose or sprinkler or with an automated irrigation system so as not to cause compaction or wash-outs of the soil or loosening of plants. The Contractor shall immediately make good any such damage, soil erosion or outwash and plants loosened by erosion are to replanted or if damaged, replaced.

All plant beds are to be kept in a weed free condition with a weeding operation once a month. All weeds, stones and rubbish collected from this operation shall be removed from the site to a tip to be found by the Contractor. Herbicides may not be used on this site unless a specific application

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in writing is made by the Contractor with full back up data on the performance of the chemicals and the particular need for the chemicals use. Approval will in all cases be subject to the Landscape Architect's decision.

After weeding, at least once per month the soil surface is to be lightly broken up between plants using a pronged fork. Taking care not to disturb the root systems. Maximum depth 100mm. After forking the soil loose, the mulch and loosened soil are to be raked to give an even re-distribution of the mulching materials

Firming up and adjusting of stakes/ties shall be carried out monthly to ensure that the trees and shrubs are firmly held in the ground. If required guy ropes or tree pits shall be adjusted, tightened or loosened. If tree ties or ropes are rubbing the bark of the trees, the ties are to be taken off and retied. Any damaged branches are to be carefully pruned and the wounds sealed.

All protective fencing is to be maintained and kept in good condition and in position until the end of the maintenance period.

Trees shall be pruned if dead, rotten or crossed branches are present or to maintain a clear stem up to the specified height using the methods described below. Tree pruning is to be reviewed monthly.

All shrubs and ground covers are to be reviewed monthly and pruned as and when required during the Maintenance Period to promote bushy growth and good flowering characteristics. The shrubs shall be checked and all dead wood, broken, damaged or crossed branches shall be cut back, depending on species. Pruning and removal of branches is to be carried out using sharp clean implements to give a clean sloping cut with one flat face. Ragged edges of bark or wood are to be trimmed with a sharp knife.

Pruning for all plants shall be carried out as follows:

☐ Pruning is to be done with the cut just above and sloping away from an outward facing health bud.

☐ Removal of branches is to be done by cutting flush with the adjoining stem and in such a way that no part of the stem is damaged or torn.

☐ Ragged edges of bark are to be trimmed with a sharp knife.

☐ Any cuts or wounds over 25mm diameter are to be painted with an approved sealant after trimmed.

☐ All pruning to be cleared up and removed from site after pruning.

All hedges, mat forming herbaceous plants and ground cover plants shall be clipped with shears as often as necessary (at least monthly) to maintain a tidy appearance. Tall hedges are to be cut to forms shown on the drawings. Fertiliser is to be applied to clipped areas around 1-2 weeks after clipping.

Selective pruning of flowering plants shall be done where special flowering characteristics are required such as for Ixoras, Hibiscus, Allamanda where flowering takes places on twig ends. Heavy clipping must not be used for these species since this will remove future flower buds. Selective pruning by clipping non flowering twigs and leaving flowering twigs is necessary for these plants, and this operation must be done by experienced workers.

The Contractor shall allow for monthly fertiliser operations during the Maintenance Period. An approved slow release fertiliser shall be applied to each plant at the rate of 50gm per shrub and 200gm per tree, one month after planting and thereafter monthly. After spreading the fertiliser around the base of the plant the granules shall be lightly forked into the soil, and the plant well watered. Herbaceous and ground cover areas shall receive 25mm of approved soil conditioner, evenly spread and mixed with 50gm/m² of approved slow release fertiliser, evenly spread over

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entire area and lightly forked into the soil to break up the top layer, and the area well watered on a month by month basis.

The horticultural requirements of different plants or areas may involve variations to those techniques (such as the use of organic liquid fertilisers for sensitive plants) and variations in method will be authorised as required.

Heavy feeding plants such as Canna, Heliconia and Lantana shall be dressed with a 25mm mulch of approved organic compost or similar approved compost every 2 months, lightly forked in around the base of the plants.

Additional mulching layer, 25mm deep to be spread and forked in over all planted areas at 3 monthly intervals.

The Contractor shall make regular weekly checks to ensure that the plant material is insect and pest and fungus free. No pesticides may be used unless approval from the Landscape Architect is given from the Contractor stating the chemical intended for use; concentration, spraying programme and including full technical details of the product.

The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Digging holes in ordinary soil and refilling the same with the excavated earth mixed with manure or sludge in the ratio of 2:1 by volume (2 parts of stacked volume of earth after reduction by 20% : 1 part of stacked volume of manure after reduction by 8%) flooding with water, dressing including removal of rubbish and surplus earth, if any, with all leads and lifts (cost of manure, sludge or extra good earth if needed to be paid for separately) : Holes 1.2 m dia and 1.2 m deep

Preparation of beds for hedging and shrubbery by excavating 60 cm deep and trenching the excavated base to a further depth of 30 cm, refilling pit with mixture of good soil and farm yard manure after mixing it in 2:1 proportion (2 parts of good soil : 1 part of farm yard manure), flooding with water, filling with earth if necessary, watering and finally fine dressing, leveling etc. including stacking and disposal of materials declared unserviceable and surplus earth by spreading and leveling as directed (cost of farm yard manure and good earth to be paid for separately) Item includes all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required as directed by EIC

Plantation of Trees, Shrubs, and Hedge at site i/c watering and removal of unserviceable material's as per direction of officer in charge (excluding cost of plant & water) Item includes all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required as directed by EIC - SHRUBS plant

Plantation of Trees, Shrubs, and Hedge at site i/c watering and removal of unserviceable material's as per direction of officer in charge (excluding cost of plant & water) Item includes all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required as directed by EIC - TREES plant

Staking of trees, palms and large shrubs using quadrapod staking made of 4 nos Bamboo 25 mm dia 2.5 metre long, fixed 0.3m in the soil and joined at 2/3 height of

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plant stem using jute rope, fixed to plant using rubber sheath; plant stem to be covered with gunny / jute cloth at fixing point to prevent damage, complete including supply of all material, labour and equipment, upto any lead and lift as directed by EIC

Cultivation of the completed soil mix beds shall take place only when the seeding or planting operations can begin immediately after cultivation. No cultivation shall be undertaken in weather or ground conditions in which operations may destroy soil structure or where soil mix has not been approved by the Landscape Architect.

Cultivation shall be by approved mechanical or manual means to a depth of 300mm for Ground Cover and 600mm for Shrubs to provide an even, weed free texture.

After cultivation, stone picking from the surface of soil areas shall be carried out such that all stones and lumps exceeding 50mm in diameter are collected. All stones, weeds and rubbish brought up shall be removed from the site to a tip to be found by the Contractor.

Ground cover, rooted shoot and herbaceous beds are to have 25mm solid conditioner spread over the entire area and well forked in to the top 250mm of soil during cultivation. This operation is separate from the mulching specified.

All plants shall be planted to accommodate the spreading root system of the plant to the same soil depth as in the nursery and shall be well watered before removing them from containers. Plants are to be positioned upright and the soil firmed around the roots.

Planting shall be carried out in accordance with the schedule of plants and drawings supplied. The number of each species and variety shall be evenly distributed over the area as indicated on the drawings.

For large areas the outer rows are to be set out first to ensure the correct shape to the bed is established. The remaining plants are then to be evenly distributed to cover the planting area. The Landscape Architect is to be notified in advance if there are too many or too few plants to fill the area required and an assessment of setting out adjustments will be directed accordingly.

Setting out of plants is to be completed and approved before planting into the soil bed can commence.

Small shrubs, ground cover and herbaceous plants shall be planted in pockets formed by a trowel or spade. The pocket shall be deep enough and wide enough to accommodate the root of the plant. The sides and base of the pocket shall be loosened and the plant roots lightly loosened from the rootball. The plant shall be placed upright in the pocket and firmed into the ground by backfilling and treading or hand pressure.

The topsoil in areas to receive rooted shoots shall be brought to a fine tilth 75mm deep by approved mechanical means or hand raking. Approved slow release fertiliser shall be applied evenly over the area at a rate of 40gms per square metre and shall be lightly raked into the surface. Rooted shoots shall be firmly bedded into the soil at 75mm centres with each shoot spread on the topsoil surface, separated from adjacent shoots. The area shall be topdressed with finely sifted topsoil/compost mix as approved by the Landscape Architect to lightly cover the rooted shoots after laying. The ground shall then be firmed by lightly treading or hand pressure around the roots, taking care not to damage the shoots, to ensure good contact with the soil. Watering shall take place immediately after planting, using a fine spray. The firmed up area is to be tightly cultivated after completion of this operation to leave an even tilth before mulching.

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Shrub pits for large and medium shrubs, feature plants and climbers shall be excavated to 150mm wider on either side than the root spread, and to a depth of 150mm deeper than the root depth and shall not be less than 300mm x 300mm x 450mm deep.

The bottom 150mm of the pit is to be forked loose prior to backfilling. Backfill material shall be garden soil mixed with manure in 2:1 proportion for backfilling purposes. The Contractor shall note that for planting into turf areas, where topsoil has not been spread topsoil mix will be required for backfilling purposes.

Climber pits shall be 150 - 200mm away from the supporting structure with the roots spread away from the wall or adjacent supporting structure. The climbing plants shall be trained through the wire mesh with leading shoots directed upwards and tied.

Pits for shrubs and feature plants in planters shall be excavated to 150mm wider on either side than the root spread and to a total depth of the rootball. The bottom of the pit shall be lightly formed, prior to planting taking care not to damage the terrain layer below.

After planting shrubs the area is to be watered immediately to bed the shrubs in. Once the water has percolated away and left the surface relatively dry the soil area is to be lightly forked to loosen the surface and leave an even soil tilth.

Before backfilling, imported topsoil and sand is to be thoroughly mixed with soil conditioner and organic fertiliser as specified for Topsoil Mix.

The tree pit shall be backfilled with the Soil Mix to a depth which will allow soil, after settlement to match surrounding ground level. The filled pit shall be watered and allowed to settle. After settlement soil levels shall be topped up as required.

The centre of the backfilled tree pit shall be excavated large enough to allow placing of the rootball, and to allow even compaction all round during backfilling. After careful removal of the container or wrapping, the rootball of trees shall be placed carefully in the pit, and soil replaced gradually into the pit. The soil is to be consolidated during backfilling in layers to ensure that the plant is firmly held in the ground and that voids are not left around the roots. Care shall be taken during planting to avoid damage to the root system, branches or leaves.

After careful removal of the container or wrapping, the rootball of the roots of shrubs and climbers shall be placed carefully and the soil replaced gradually in the pit. The soil is to be consolidated during backfilling in layers to ensure that the plant is firmly held in the ground and that voids are not left around the roots. Care should be taken during planting to avoid damage to the root system, branches or leaves.

Stakes shall always be used when trees when directed by the Landscape Architect. Stakes shall be in sawn timber of an approved type and be carried out according to the size of plant to be supported. The types of approved staking methods are:

Tripod or quadropod staking for palms and trees

Three or four stakes each 50 x 50mm section shall be positioned equidistantly around the tree and firmly driven into the ground at angles of between 30 - 40 degrees from the vertical. The inner ends of the stakes shall extend beyond the tree stem by not more than 150mm and shall not be higher than 300mm below the lowest branch. The tree stem shall be wrapped in gunny sacking at the point where the tree stakes are to be fastened in order to prevent bark damage. The stakes shall be neatly and firmly fastened to the tree stem using rubber hose or cord. String is not to be used. The stakes are to be adjusted and the position of the protective wrapping is to be altered up or down every month. The gunny sack wrapping is to be sprayed with an approved

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horticultural pesticide.

Climber wires for training climbing plants against walls shall be approved lightweight PVC mesh, fixed at 600mm intervals to screw eyes supplied under the sub contract. Maximum mesh coverage shall be 180mm high x 240mm wide. The climbing plants shall be trained through the wire mesh with the shoots directed upwards and tied.

After planting all plants are to be thoroughly watered using enough water to soak the ground all around the rootball. After watering and the water has percolated away leaving the surface relatively dry the soil is to be lightly cultivated to give an even soil tilth.

After completion of planting and watering and light cultivation operations a 50mm deep layer of approved mulch shall be spread and forked in over all cultivated planting areas. Around each tree and palm and around the base of each climber, additional mulch is to be applied to a 50mm depth to a diameter of 600mm. Mulching is to be done within 2 days of completing planting and watering in.

After a period of settling in of at least one month, all pit planted materials shall be fertilised with an approved slow release fertiliser at the rate of:

Trees: 250gm per tree

Shrubs/climbers: 50gm per plant

Ground Cover/Herbaceous/ Rooted Shoots: 100gm per square meter spread around the base of the plants

All fertilised areas are to be watered immediately after fertiliser application.

The Contractor shall take all necessary precautions to prevent or eradicate any outbreak of disease or insect attack.

Where planting is to be carried out in areas of turf, the turf shall be carefully cut to the size of the tree or shrub pit, rolled and stored for re-use, being kept moist and in shade. After planting the turves shall be re-laid around the base of the plant. The Contractor shall replace at his own expense, any turves which are damaged during planting operations.

The contractor shall be responsible for protecting all planted areas. If it is necessary for the Contractor to erect protective fencing, the Contractor shall be responsible for keeping the fencing in position and in good repair until the end of the maintenance period. Fencing proposals shall be submitted to the Landscape Architect for approval. Post and string fences shall not be acceptable.

After planting and prior to the onset of the maintenance period, the Contractor shall be responsible for carrying out all necessary measures to ensure that the plant material thrives and becomes established and that the landscape areas are kept in a clean and tidy condition.

The Contractor shall allow for carrying out the following maintenance operations when necessary prior to the onset maintenance period:

☐ Replacement of dead/missing plants

☐ Grass cutting around trees

☐ Watering

☐ Cultivation and loosening of soil

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- ☐ Weeding
- ☐ Pruning and clipping
- ☐ Firming up and adjusting stakes and ties
- ☐ Eradication of pest or insect attack
- ☐ Topdressing and mulching
- ☐ Fertilising

The Contractor shall be responsible for replacing any plants which fail to survive as a result of inadequate maintenance operations, poor workmanship or poor quality of plant material prior to completion.

The Completion Certificate will not be issued until all plants scheduled on the Drawings and Schedule of Works are installed in a healthy condition in the manner specified.

The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Measurement

Measurement for pit preparation of tree and single stemmed palm pits shall be in numbers.

Measurement for pit preparation of shrubs and other plants shall be in square metres, accurate to the nearest metre.

Measurement for planting all plants shall be in numbers.

Measurement for staking shall be in number of plants staked

The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

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Supply of Shrubs - well developed, well branched - 3-4 branches each having 4-5 leaves, preferably in bloom, in polybag of 30x20cm size, disease free and development (height 0.75-0.9m) Shrubs are woody perennials of generally multi stemmed and bushy habit ranging from 3 - 4.5m down to 500mm height. Shrubs shall have no less than three main stems and shall be well balanced and bushy, with strongly developed fibrous root systems, and shall be pruned in advance as required to achieve the specified height tolerances. Branches shall break from the base of the plant just above the root collar, and shall be well furnished with leaves right down to ground level. Supply shall include labour & equipment cost of loading, unloading, transport to site, storage & stacking within site in area protected from dust using temporary agronet, watering & maintenance at stacking area until planted as directed by EIC

Supply of Trees - well developed, well branched crown - 4-6 branches each having 4-5 leaves, well developed (Poly bag size - 30"x 30", min. stem diameter 50mm and height as specified) Trees shall be large size nursery grown trees pruned during growth to produce a tight well rounded head and a straight stem clear of leaves or twigs. Trees shall be at least two years old, as certified by the nursery. Trees shall be 70-100 mm circumference stem when measured 1.0m from ground level and shall have a clear straight stem of minimum 1.2m. The head shall be well balanced and rounded and contain at least four main branches with a well-developed secondary branch system and a defined central leader that has not been pruned, giving a minimum overall height of 1.5m at the time of planting. Rootball dimensions : diameter 750mm x 750mm deep minimum. Branching/leaf spread 1.5 - 1.8m diameter. Pruning at the time of removal from the nursery will not be permitted. In dry weather conditions, trees are to be sprayed with approved Anti-transpirant. Trees shall have a strong fibrous root system. Supply shall include labour & equipment cost of loading, unloading, transport to site, storage & stacking within site in area protected from dust using temporary agronet, watering & maintenance at stacking area until planted as directed by EIC

"Supply of Palms - well developed, well developed, disease free (Poly bag size - 18""x 18"") Palms shall have heights as either 1.2m-1.5m. For single stemmed palms, the clear trunk height shall be atleast 80% of specified height, and stem girth shall be of dimension normally found for palms for the stem height and species specified. Acceptable tolerances to variations in stem height shall be +200mm or -200mm from the height specified in the Bills of Quantities. The heads of palms shall be well balanced with at least 7 leaves and a healthy growing apical shoot all free from pest and disease. Rootball dimensions shall be 450mm diameter x 450mm depth. Supply shall include labour & equipment cost of loading, unloading, transport to site, storage & stacking within site in area protected from dust using temporary agronet, watering & maintenance at stacking area until planted as directed by EIC"

Supply of Ground covers / creepers - well developed, min. 0.15m high, in polybag of 5"x7" size, disease free. All groundcover species shall be evenly balanced to allow equal growth in all directions. Plants shall have fully developed roots and leaves. Rooted cuttings will not be accepted. All plants to be container grown. Supply shall

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include labour & equipment cost of loading, unloading, transport to site, storage & stacking within site in area protected from dust using temporary agronet, watering & maintenance at stacking area until planted as directed by EIC

The plants supplied should be as per following specification in addition to specification mentioned in descriptions:

1. The plants should be full of fresh and healthy foliage.
2. The plants should be free from insect, pest and disease.
3. Plant should be healthy and vigorous growth
4. The height of the plants will be measured from top of the pots.
5. The plants should be well settled and should not be newly shifted.
6. The plants should be true to the variety and named Variety should be tagged.
7. Moss stick used should be made on plastic pipe.
8. Moss stick should be straight and properly fixed in the pot.
9. The rejected plants materials should be removed from the site immediately.
10. Moss stick should be covered with the plants in case of plants supplied with moss stick.
11. The Plant should be well established and good spread.
12. Good earth and manure used for filling the pot/poly bag free from any inert material and mixed to proper ratio.
13. Pot/ Poly bag used for filling the plants should be proper size good quality not damaged.
14. There should be proper drainage in pots for plants.
15. The flowering plants should also have proper flowering and should be true to the variety.
16. All plant should have the tendency of growth and should not be stunted type.
17. There should be no stagnation of water in the pots

Heights of plants shall be as per descriptions in bill of quantities

Measurement shall be in numbers of plants installed on site.

Supply and Grassing with Vettiver grass at 0.3m c/c including watering and maintenance for the slope stabilization for 180 days or more till the grass forms a thicket, sapling with well-developed root system, in polybag, disease free, and development including excavation up to 450mm deep, complete including supply of all material, labour and equipment, up to any lead and lift as directed by EIC

Vettiver grass supplied must be at least 0.5m high with 5-10 shoots and well grown root system within 15x25cm polybags, and at least 6 months old.

Vetiver should be planted across the slope on approximate contour lines with a Vertical Interval (VI) between 1.0m apart, measured down the slope.

The first row should be planted on the top edge of the slope. The bottom row should be planted at the bottom of the slope. Between these rows, vetiver should be planted as specified above.

In dry weather, water every day during the first two weeks after planting and then every second day. Water twice weekly until the plants are well established. Mature plants require no further watering.

During the first month after planting, replace all plants that fail to establish or wash away. Continue inspections until the plants are suitably established.

DAP or NPK fertilizer should be applied at the beginning at 100g per linear meter (row).

The rate includes the cost of all materials, equipment, labour, carting, loading & unloading,

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removal of debris to local specified within the site, involved in all the operations described above.

Plants that do not reach the specified dimension or quality, characteristics in this section or in the sizes and descriptions set out in the Bill of Quantities will be rejected and will have to be replaced at the Contractor's cost.

Measurement

Measurement shall be in area of vetiver planted at 0.3m c/c, measured to the nearest metre. This work shall include transport, loading, installation. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Supply & installation of Coir based Geotextile 700 gsm (H2M8) conforming to IS 15868 : Part 1 to 6, for covering top of erosion prone slopes or embankments as per IS 15872:2009; fixed to ground as per drawing, including all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required as directed by Engineer-in-Charge

Material shall be supplied conforming to IS 15868: Part 1 to 6. Contractor is required to provide certification for the same along with sample of material for approval of Engineer-in-Charge before supply of material to site.

This item shall be carried out for coir geotextile lining works of excavated areas surrounding water body, as per IS15872:2009 - Application of Coir Geotextiles (Coir Woven Bhoovastra) for Rain Water Erosion Control in Roads, Railway Embankments and Hill Slopes – Guidelines.

Geotextile shall be unrolled downhill from top of slope to be applied.

Overlaps on all sides between two geotextile pieces shall be minimum 15 cm.

Coir geotextile shall be clamped on the steep slopes using U shaped Stainless Steel staples, having minimum 220 mm length and 11 gauge. Geotextile shall be pinned to the ground using these staples at every 0.50m to 0.75m in longitudinal and transverse direction.

Measurement

Measurement shall be in square metres of area covered on site by coir-geotextile lining. This work shall include transport, loading, installation. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Irrigation Works

Technical Specifications

A) Irrigation

Piping Materials

General:

All sizes are in metric unit; whereas equivalent imperial unit shall be used in case of imported material.

1 HDPE Pipes and Fittings

The pipes shall be round and shall be supplied in straight lengths or Coils. The internal and external surfaces of pipes shall be smooth, clean, and free from grooving & other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designed by external diameter and shall conform to IS: 4984. The pipes shall be of equitant pressure Class as described in BOQ.

Fittings:

Fittings for HDPE pipes should be Compression fit type Compression tees, elbows, bends, junctions, Reducers etc; as required/directed at site, Make: Astore, GF, FIP, should be minimum of PN10

uPVC Pipes and Fittings

The pipes shall be round and shall be supplied in straight lengths with socket ends. The internal and external surfaces of pipes shall be smooth, clean, and free from grooving & other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designed by external diameter and shall conform to IS: 4985: 1988/2000 & ASTM 1785. The pipes shall be of equitant pressure Class as described in BOQ.

Fittings

Fittings shall be injection molded and shall be 10 kg/cm² pressure rating and to conform to Indian Standard, however all bends should be fabricated from 10kg/cm² Pipes & Sch 40 & 80 Fittings for PVC Pipes as per ASTM 1785.

2. DWC pipes:

The pipes shall be designated by nominal diameter and shall conform to IS: 16098. The internal and external surfaces of pipes shall be corrugated. The pipes shall be of SN 4 & 8 stiffness class. Pipe should be used in Swell as well for Road Crossing.

3. Galvanized Iron Pipes & Fittings

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The pipes shall be galvanized mild steel welded (ERW) or (HFW) screwed and socketed conforming to the requirements of IS: 1239. The Galvanizing shall confirm to IS:4736, the zinc coating shall be uniform, adherent reasonably smooth and free from such imperfections as flux, ash and drop inclusions, bare patches, black spots, pimples, lumpiness, runs, rust strains, bulky white deposits and blisters. Class of GI Pipe should be C Class.

4. Pressure Compensating Dripper Line (In-Line)

- a) The drip line tubing shall be extruded from virgin linear low-density polyethylene (LLDPE) tubing with pressure compensating emitters co-extruded at the designed intervals.
- b) The pressure compensating dripper shall consist of "dual regulation" utilizing both turbulent flow labyrinth and EPDM diaphragm. The dripper shall be continuously self-cleaning and should have an inlet filter capable of being cleaned by flushing the line. Pressure compensation shall be between 0.5 kg/cm² to 4 kg/cm². The coefficient of manufacturing variation of the dripper must be less than 0.04 as determined by an independent organization.
- c) The drip line must have warranty against solar radiation damage for 7 years or more.
- e) The drip line shall be able to be installed with the dripper in any orientation.
- f) Temperature up to 60 °C should not affect dripper flow rate.
- g) The dripper shall have a large "water path" outlet that acts as a mechanical barrier to root intrusion.
- h) The drip line shall have an outer diameter 16 mm and inside diameter of 13.6mm and in dripper flow rates of 2.2 to 2.4 LPH with co extruded dripper spacing 40 cm.
- i) Drip line should be brown in color and wall thickness should be minimum 1.2 mm.
- k) All the poly fittings should be of 17mm.
- l) Take off connections should be made by fixing a clamp saddle on PVC / HDPE Lateral, Sch 40 Pipe should be fixed on it and brought up to Ground level. On top of Pipe Threaded inlet and Barbed outlet 17mm Tee to be fixed and on outlets Drip lateral to be fixed. No Gromate take off connection on PVC / HDPE Lateral to be used,

5. Pop up Sprinklers

Gear Driven Sprinkler

- a) The sprinkler shall have a minimum 4-inch pop-up stroke. The pop-up sprinkler shall be available with a drain check valve (SAM) to prevent low head drainage and be capable of checking up to 10 feet of elevation change.
- b) The body and riser of the sprinkler shall be constructed of non-corrosive, heavy-duty A.B.S. plastic.
- c) Rotor shall have mechanism to turn it on/off from the top for easier maintenance.
- d) Rotor shall have inbuilt Pressure regulating device which ensures no misting of jets and also uniform distribution of water.

Gear Driven Pop-up Sprinkler 4" (4" Pop Up Height from bottom to Centre of Discharging Nozzle) (9 to 14 mtr Radius, Flow - 0,18 to 1,37 l/s, pressure - 2,1 to 6,2 Bars) with Check Valve complete with required

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nozzle. Make : Rain Bird/Toro/Nelson

Spray Pop-up sprinkler 4" (1.5 to 7 Mtr Radius) Flow 2.8 LPM to 15 LPM, maximum 2.1 Bar with Check Valve, Wiper Seal, Flow Shield, inbuilt pressure regulator complete with required nozzle Make: Rain Bird/Toro/Nelson.

PP Clamp Saddles: PP Clamp Saddles should be made of high density Polymer having NBO-ring, Zinc Chromed Steel Nut Bolts Packed in PE Bag individually

Swing Joint

- a) All the connection between pipe to sprinkler and pipe to QCV shall have swing joint risers or an approved equivalent with "O" ring sealing for the threaded joints.
- b) The length of all swing joint risers will be 300 mm or as per site requirement.
- c) Swing Joint should have four elbows for easy installation.
- d) Swing Joint pressure rating should not be less than PN 10.

6. Valves

Mainline Isolation Valves:

- a) Mainline isolation points will be achieved by installing butterfly valves at designated locations. These valves will be housed in valve boxes.

PVC Butterfly Valve for Main Line Isolation: EPDM seals, galvanized steel stem, Torque is 25 n/M. Leak and corrosion resistant stem for easy operation.

Sub Main Valves

- a) All section will be isolated by installing a PVC ball valve at the point of takeoff from mainline.
- b) Valves will be PVC ball valve or approved equivalent.
- c) They will be housed in valve boxes

PVC ball valve for sub main valve should be true double union type. Pressure rating is PN 16. Solvent weld and as per ISO: 727. PVC ball valve should have round ball, EPDM rubber ring. Leak proof Body.

Air Valves

- a) Air Valves will be 25 mm/ 50 mm double acting air/vacuum release valves or approved equivalent. These valves will be isolated from the mainline by gate valve.
- b) Air valves will be installed so that they are a minimum 100 mm and a maximum 200 mm below grade.
- c) Round valve box should be installed on each air valve for protection & identification.

Quick Coupling Valves

- a) Wherever required the Quick Coupling Valve will be 25 mm brass quick coupling turf valves.
- b) Each QCV will be secured with proper stake or other method to avoid movement of it.
- c) 25 mm brass coupler keys and swivel hose elbows shall also be provided by the contractor to

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enable use of the QCV's.

- d) Each QCV will be isolated with gate valve and covered with Round Valve Box.

Valve Boxes

- a) All valve boxes shall be made of reinforced fiberglass of similar and lid be green in color.
- b) All valve pits will be constructed of bricks.
- c) There will be no contact between the pipe and the valve box or valve pit.
- d) All valve pits will have a minimum fill of 100 mm of washed pea gravel.
- e) Solenoid valves, isolating valves, flush valves and quick couplers shall be installed in an access box of sufficient size to permit ready removal of the valve inner assemblies without removing the box from the ground. Valve numbers and station numbers must be clearly marked inside and outside to the box with a permanent paint or by using plastic tags.

Hydrometer / Water Meters

Water Meter should be Magnetic Drive Dry Type, having removable and interchangeable measuring element, Magnetic transmission, Meets ISO 4064 class B-H, EEC Approval. Should have digital / pulse output for transmitting data to central / scada system.

Suitable valves chambers or wall meter box to house the meters shall be provided along with the meters if it is installed outside.

Water meters shall be provided for monitoring water consumption in each cluster.

Water meter provided at the Main line after the pump shall have normally master valve Capability.

GM & Other Metal Valves

All valves (gate, globe, check, safety) shall be of gun metal suitable for the particular service. All valves shall be of the particular duty and design. Valves shall either be of screwed type or flanged type, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces shall be supplied along with valves. Gate, globe and check valves shall conform to Indian Standard IS: 776 and non-return valves and swing check type reflux to IS: 5312.

Pressure Relief Valves

1. Quick Pressure Relief Valve, hydraulically operated, diaphragm actuated control valve to relieve excessive system pressure when the pressure rises above the pre-set value.
2. It should immediately, accurately, and with high repeatability responds to system pressure rise by fully opening.

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3. It should be Line Pressure Driven and shall have long term drip tight sealing.
4. It should have long term setting stability with wide setting range.

6. Irrigation controller:

Controller shall be a decoder type controller working on 2 wire principle it should have below features:

- a) Minimum 50 station capacity, expandable to max 200 station through two expansion module of 75 station each.
- b) It should have 5 master valve, 5 flow sensor and 4 weather sensor capability.
- c) Four independent programs with capability to overlap.
- d) Cycle-Soak by station, Rain Delay and Calendar Day Off
- e) Programmable Station Delay by Program, Program-level and monthly Seasonal Adjust.
- f) Flo-Manager for management of your system's hydraulic capacity.
- g) Flo-Watch for SEEF (Seek and Eliminate Excessive Flow) and SELF (Seek and Eliminate Low Flow) for automatic diagnosis and management of mainline breaks or underflow.
- h) Learn Flow and User-Entered flow supports automatic learning or user-estimated flow rates.
- i) Flow logging for monitoring and conservation of water consumption.
Supports English (GPM) and Metric (LPM, LPS, M3/s) flow rate measurement

Solenoid Valve

Should have followings features:

- a) Durable glass-filled nylon construction or heavy durable Plastic with fabric-reinforced rubber diaphragm for long life and reliable performance.
- b) Globe configuration with BSPT female inlet and outlet
- c) Normally closed, forward flow design.
- d) Slow closing to prevent water hammer and subsequent system damage.
- e) Low flow capability for a wide range of applications.
- f) One-piece solenoid design with captured plunger and spring for easy servicing.
Prevents loss of parts during field service.
- g) Flow control handle adjusts water flows as needed.
- h) Manual internal bleed manually operates the valve without allowing water into the valve box; allows pressure regulator to be adjusted without turning the valve on at the controller first.
- i) Manual external bleed permits flushing debris from the system. Recommended for system start up and after repairs.
- j) Stainless steel studs molded into the body. Bonnet can be attached and removed more easily and more often without damaging threads.
- k) Pressure range: 1,5 to 13,5 bar
- l) Flow with Pressure regulation option: (0,32 to 12,60 l/s)
- m) Temperature: Up to (66° C)
- n) Accommodates optional, field-installed Pressure regulator to ensure optimum sprinkler performance.
- o) Accepts latching solenoid for use with battery-operated controllers.

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Decoders

There are two type of decoders namely field decoder, and sensor decoder, field decoder operates the field valve while sensor decoder interface with sensors used in the system like flow sensor, weather sensor etc.

Decoders should have following features:

- a) It should be encapsulated fully water proof having nominal voltage of 34Vpp (24V AC) from two-wire line- Minimum voltage: 21 Vpp (15V AC)
- b) Have single station and multi station capability arrangement in different body arrangement.
- c) Pre-coded from factory no switching is required in the field.

Flow sensor:

Flow sensor is used to monitor line flow at real time in an Irrigation system, it should have following features.

- a) Accuracy: $\pm 1\%$ (full scale)
- b) Velocity: 1/2 - 30 feet (0,15 - 9,2 meters) per second, depending on model
- c) Pressure: 400 psi (27,5 bars) (max) on metal models; 100 psi (6,9 bars) (max) on plastic models
- d) Temperature: 220° F (105° C) (max) on metal models; 140° F (60° C) (max) on plastic models

Maxi Cable:

Decoder Jackated Direct Burial Irrigation Automation Cable 14 AWG / 1.5 Sq.MM white Make: Paige/Rain Bird/Toro - Tin coated copper conductors, insulated with PVC and having a high-density polyethylene direct burial jacket. Conductor - Soft annealed tin coated solid copper conforming to ASTM B-33. Insulation: Polyvinyl Chloride conforming to UL Standard 493 for TYPE UF/TWU rated 75°C. Outer Jacket: Pressure Extruded High Density PE conforming to ICEA S-61-402, and NEMA WC5 Jacket Thickness 3/64" minimum jacket material to completely fill interstices between the two insulated conductors.

Pressure Regulating devise:

Pressure regulator shall regulate and maintain constant outlet pressure between 15 and 100 psi (1.04 to 6.9 bar) within ± 3 psi (± 0.21 bar). Should have adjustment knob with detents to permit fine-tune setting in 1/3 psi (0.02 bar) increments.

Pressure Gauge

The pressure gauge shall be constructed of die cast aluminum and stove enameled. It shall be weather proof with an IP 55 enclosure. It shall be a stainless steel Bourdon tube type pressure gauge with a scale range from 0 to 10 Kg /cm2 and shall be constructed in accordance with IS:3524. Each pressure gauge shall have a siphon tube connection. The shut off arrangement shall be by Ball Valve. Gauge dial should be 4 inch.

7. Filtration Unit

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- a) Filter should be Fully Atomized Screen Filter and had minimum Water Losses at the time of Backwash
- b) Backwashing should initiate after reaching of set pressure differential threshold between the inlet and outlet manifold.
- c) The filter is to have a maximum 2 m pressure loss across it.
- d) The Contractor is to provide full details and operating characteristics of the filter he intends to use on this system including pressure loss and backwash water requirements for approval by the Engineer In charge.
- e) Filter should have its screen element with mesh of 100 micro size, it should be economical element with high filtration efficiency, should have minimum 1600cm² Filtration Area.
- f) Maximum operating pressure should not be less than 8 kg/sq.cm
- g) Filter should be installed with three butterfly valves on a galvanized inlet & outlet manifold.

8. Pump Station:

The contractor shall supply the required / specified pump station of reputed make conforming to IS or international standards. The pump body has to be of SS/CI & the rotor is to be copper.

It should be a VFD Based Pump Station mounted on a Power Coated / Hot Deep Galvanized Skid / Header giving flow of 33m³/Hr. at 65m head complete Set (1 working + 1 stand by) with Suitable Pressure Tank, Inlet & Outlet Valve, Check Valves. Pressure Gauge, VFD Panel having individual Pump Control from outside of the panel & all required accessories. Make: Grundfos/ITT/Lubi

All necessary / required accessories & fittings required for the connection / installation / erection of moonset pump set are included in the supply rates.

The moonset pumps are to be installed in the Underground pump rooms specified in the layout / directed by ENGINEER I/CGN's .

9. Laying of pipe work.

- a) Pipes will be laid in the routes and sizes as indicated on the drawings and stated in the relevant sections of this specification. In the case where multiple pipes or electrical conduits are laid in the same trench, they must be located side by side, not crossing each other or stacked one upon the other.
- b) All pipe laying and jointing will be performed in site in the trench on the prepared bedding; not assembled above ground and placed in the trench at a later stage.
- c) At the end of each day's work, all open ends of pipe work and conduit will be plugged and staked to prevent entry of vermin, dirt, water or moisture and movement of the pipe.
- d) Where pipe is required to pass over or under drainage pipe, the Contractor is to ensure a minimum clearance of 100 mm between the irrigation pipe and the drainage pipe.
- e) Main Line Trench Should be 600 mm + Mainline Size and Sub main should be 450 + Sub main size.
- f) Refilling trench with good soil and free from any rock/ stones.
- g) Mainline Pipe should be Tested as per IS Specification.

Crossings at Road or drainage pipe:

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Electrical Cables (Common to all crossings)

- a) High voltage cables
 - i) A separate PVC electrical conduit will be installed for the high voltage cables.
 - ii) The high voltage cables must not share a conduit with low voltage cables
- b) Low voltage cables
 - i) This conduit must be separated by minimum 300 mm from the high voltage conduit (if any).
- c) Conduit
 - i) The size of the conduit will allow easy pulling through of cables. In any case, the minimum size conduit used will be 25 mm.
 - ii) If the conduit is exposed to sunlight, it will be Ultra Violet resistant.

Road crossing

- a) Pressure pipe

Where the pipe work goes under a road, the contractor will install:

 - i) DWC pipe sleeve of sufficient diameter to allow easy installation of the bell-ended PVC pipe.
 - ii) GI pipe of equivalent internal diameter to the PVC pipe.
- b) Depth

The minimum depth of the sleeve and conduits will be 750 mm measured to the top of Ground.
- c) Ends of sleeve and conduits

These will be clearly marked above ground for ease of future location and End will be closed outer dia with cap to reducer entry of any foreign material in sleeves.

Trench Work:

Mixing of soil layers:

When the depth of the trench extends through different soil structures (e.g., sand capping, topsoil, clay, and native earth), the contractor will:

- a) Remove each layer and place it separately on the surfaces.
- b) Refill the trench to restore the original layers of soil.
- c) Mixing of the different soil layers is not limited.

Mainline Excavation

- a) Trenching for mainlines will be performed by hand digging only
- b) The depth of trench for mainline shall be minimum 600 mm + Pipe diameter from the finish ground level.
- c) The material removed whilst digging will be placed no closer than 300 mm to the top edge of the completed trench and there will be a minimum of loose soil left in the bottom of the trench prior to

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pipe laying.

Sub-main/Lateral line Excavation

- a) Trenching for lateral lines will be performed by hand digging or by backhoe with a maximum bucket width of 300 mm, to minimize disturbance to the surrounding area.
- b) The depth of trench for sub mainline shall be minimum 450 mm + Pipe diameter from the finish ground level.
- c) These trenches will be straight with the bed level and graded.

Back Filling

Where trench work encounters unsuitable bedding material such as hardened clay, rock, shale, loose stones, excessive tree roots, etc. a 100mm bed of sand or loam will be placed below pipe in the trench prior to pipe laying.

- a) This policy will apply to back filling of all trenches, where the pipe will be covered with 100 mm of sand or loam to prevent similar debris coming in contact with the pipe or control cables. Under no circumstances will construction debris of any kind be included in any back fill material.
- b) Allowances should be made for back filling during the heat of the day to minimize the effects of thermal expansion and contraction on pipe already laid.
- c) Trenches will be back filled on the same day as they are excavated. i.e., trenches will not be excavated until required. This is to prevent flooding of trenches and floatation of pipes.

Compaction

- a) Compaction should take place only after suitable bedding and back filling has been completed to the satisfaction of the ENGINEER I/C .
- b) Compaction can be achieved by either:
 - i) plate compaction in layers not exceeding 300 mm
 - ii) wheel rolling with a suitable vehicle after 450 mm of cover is provided.
- c) Regardless of which method is used, it will remain the Contractor's responsibility to ensure reinstatement of trench subsidence during both the contract and the defects liability period.

Staking:

The staking of the mainline, sprinklers, valve and controller will be done by the contractor subject to approval by the Engineer I/C Representative.

Thrust Blocks

- a) Mainline concrete thrust blocks will be placed on all fittings that are subject to unbalanced thrust forces created by pressure and fluid movement. That is, at all mainline bends, tees, reductions, expansion, caps, isolation valves etc.
- b) NN to suit the nominated total flow rate of the particular station / Systems Flow.

B) Aerator

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5 H.P. Aerator Unit Including of Black Float constructed of High Quality Polyethylene shell and filled with closed cell foam, proactive pockets molded into the float to 'snap in' light fixtures, Maintenance free - corrosion resistant marine grade 18 Gauge/SS 316 grade stainless steel motor housing, g- type sealed, oil-cooled 3450/2875 RPM motor, Power control center with Industrial Grade Thermoplastic screen to keep debris out.

(Make: Oase / Otterbine / Crystal)

Test Parameters: Should be Approved & listed with ETL & ETL-C, Carrying independent CE Mark.

Performance:

Pattern: Tri-Star/Equinox

Spray Height: 4.6 Meter

Spray Diameter: 0.9/3.8/6.1

Volume: in m³/hr: 59m³

Voltage/Phase/Amp: 400/3/4

Warranty: 5 Years - Minimum

Aerator – Lights – MR/LED 20 Watt light set of 4 Lights for each Aerator unit, tested and approved by ETL & ETL-C

Aerator Cable – Copper Armoured Cable of different sizes – Make -Finolex / Poly Cab or RR.

Aerator Control Panel – Panel should be of NEMA 4/IP 65 rating, include surge/lightning arrestor, 24-hour timer, hands-off auto switch, external reset and people protection GFCI or EPD.

C) Water Feature:

Stream Jet:

Single Jet nozzles 1 Inch shall generate a clear, full jet that is stable in wind. Made of durable chromed and nickel plated brass. Clear wind-stable full jet Up to 15° vertically pivoting ball joint.

It should be water-level independent with flow director, can work as a single fountain or in groups of nozzles. It shall have 14.0 mm nozzle orifice and have dimension of 47 x 118 mm (Ø x h)

Water Switches Valve / Pump: Molded plastic (ABS, Acrylonitrile Butadiene Styrene, UV protected) body with male (outside threaded) 1 1/2" NPT Inlet and 2 x 1 1/2" NPT Outlet Pipe connections for NPT or BSP pipe fittings. A stainless-steel body low voltage, 3-way solenoid water service, breather control valve is fitted to the Water Switch body. This solenoid valve has a submersible coil with plug in connection to the supply cable of standard cable length of 2.7m / 9.0 Feet. The solenoid valve needs to be fully accessible for servicing. Custom made larger & longer size electrical cable with direct connection to solenoid valve coil without disconnect should be available at no extra cost. As the solenoid valves are voltage sensitive, Low Voltage Test Device with colour coded binder posts can be inserted between supply cable and solenoid valve to test actual operating voltage with suitable multi meter voltage tester.

RGB LED Light:

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24 V DC, 16 Watt, Compatible to DMX -512, Ring & floor mountable type with Power Cables & Junction Box with required Fittings & Accessories as per Drawing and Specification as directed and approved by EIC.(Sample to be approved) Nozzles can be integrated in the middle of the LED spotlights to illuminate the fountain. The LED-RGB light shall come with high quality stainless steel housing capable of installation in fresh-, pool- and saltwater. Wet and dry installation - watertight, in accordance with IP 68 protection rating shall be RDM-DMX capable with underwater LED driver. In underwater application intelligent heat management and quality LED shall ensure a lifetime of up to 100,000 hours.

Cord Seals - Providing & Fixing of Cord Seals to the cable entries at the Junction Boxes. Card seals are used to connect different type of light fixture/water switches/solenoids of varying cable sizes to the junction boxes. Card seal should be made of Brass and should be fitted with Neoprene glands for making it water tight. Sizes of card seal must be as per the sizes and core of the cable entering to the junction and coming out of the junction box.

Junction Box - Providing & Fixing of Junction BOX for RGB 12 VAC & 24 VDC Network Routing. The Junction boxes should be flush mounted type made of cost bronze with neoprene cover gasket. These Junction Boxes should be water proof with the water proof inlet and out ports for Cables in and out. Number of in and out ports should be as per requirement of cable/light/water switch grouping. Maximum 4-6 fixtures are allowed per junction Box. The entire inlet and out let ports should be sealed using card seal and sealant epoxy.

DMX Terminator & Splitter - Providing & Fixing of DMX Terminator & required Splitter with DMX Cable # 18 x 2 core. DMX terminators to be used at the last leg of each cable path and similarly DMX splitters of approved makes to be used at the Junction/branching of DMX Cable.

Show Control System - Designing, Providing & Commissioning of Show Control System with all required Accessories as per approved & as per engineer I/c, sample to be approved. The control system should be comprised of hardware and software if any, inclusive of programming relays giving out 24 V AC/DC or 12 V AC/DC output to run the solenoids and/or light fixtures.

Pump/pressure boosting for the nozzles:

Bidder shall include this in the cost of switch valve/pump as per the requirement to give the stream jet the required height as envisaged.

Filtration System:

Fully Automatic Self Cleaning mechanical biological Filter 25 m3/hr with Back Wash arrangement. It should have suitable UV disinfection kit attached to it. System should come with the required pump and other required accessories to make it a complete system.

In addition to the filtration system as per aforesaid, Chlorine Dosing system with 100 Litre Solution tank - discharge 5-7 LPH complete with all required accessories to make it self sufficient working system shall also be provided.

PVC Pipes:

PVC Pipes of sizes 110mm OD and above shall be as per IS 4985;2000 with 10kg/cm2 pressure rating, pipe sizes 3 Inches and below shall be of Sch. 40 & 80 standard as per ASTM D 1785, PVC Fittings must be injection moulded with minimum PN 10 rated. Including of Fittings like Tee, Elbow, Couplers, Reducers, Flange Pcs, Ceiling Hang / Tie Clamps, Branch Tapping Saddles etc as directed and

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approved by EIC. (Sample to be approved)

Successful bidder will have to furnish Test Report from CIPET of all pipe samples collected by **RANCHI** at his own cost.

Valve:

All Valves to be provided & fixed with required Fittings & Accessories as per Drawing and Specification as directed and approved by EIC.(Sample to be approved)

PVC Butter Fly Valve should be a flanged joint type, made of PVC from reputed brand as given in the schedule of quantities and be of minimum 6 Bar Pressure Rating

NON Return Valves should be a flange joint type, made of PVC from reputed brand as given in the schedule of quantities and be of minimum 6 Bar Pressure Rating.

Gun Metal Valve should be screwed joint type made of Brass from reputed brands as given in the schedule of quantities and be of minimum 10 Bar Pressure Rating.

Motorized / Solenoid Valve should be made of Heavy Duty Plastic or Metal, to be Operated with 24 VAC Power Supply with Minimum 10 to 15 times Opening and closing in one Minutes

Fittings

All PVC Fittings should be of minimum 10 Bar Pressure Rating, Confirming to IS 7834-1975 and from reputed brands as given in the schedule of quantities.

PP Clamp Saddles should be made of high density Polymer having NBO-ring, Zinc Chromed Steel Nut Bolts Packed in PE Bag individually.

General remark on product specifications:

All products must be as per specified in Tender documents and its annexure. It should be of reputed make and must be as per given approved make. Contractor will be responsible for all cost if found to replace the products other than the specified without written consent of ENGINEER I/C or its consultant.

Testing Procedures

Adjustment of the system:

The contractor will adjust the various components of the irrigation system to ensure the overall operation of the system is efficient. This includes the programming of the irrigation control system and adjustment of part circles sprinkler heads.

Static pressure test

- a) A static test of two hours at 1.5 times the working pressure of the mainline above 110 mm (but no higher than the pressure rating of the pipe) will be performed if required at the completion of the tapping band installation stage of each section of the mainline.
- b) During the period of the static test, the pressure will not drop by more than 0.25 kg/sq.cm
- c) All isolation valves and thrust blocks must be in place and cured for the mandatory period of time.
- d) Air valves, quick coupling and lateral valve assemblies must be completed and the lines thoroughly flushed and primed prior to testing.
- e) There will be no permissible leaks at any point in the system.
- f) All tests will be carried out by the contractor and approved by the ENGINEER I/C's .

Commissioning:

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- a) The commissioning of irrigation controller system will be carried out by the manufacturer in conjunction with and approved by the Engineer I/C .
- b) The commissioning will include, at the time of hand over, a demonstration of all sections and individual elements pertaining to the operation of the irrigation system.

Hand Over

Before hand over, the Contractor shall ensure the following;

- a) In addition to the static pressure test or commissioning, the completed system must be operated without fault for at least fifteen days prior to hand over.
- b) Should any major leaks occur during this period; the static pressure test procedure will be repeated once the problem has been rectified?
- c) If the system is repaired, then it must operate for at least fifteen days without fault prior to hand over being accepted.
- d) In lieu of an official hand over, any works properly tested, commissioned (if applicable) and used by the ENGINEER I/C for at least fifteen days without fault will be deemed as handed over.

Documentation

As Constructed Drawings

These drawings scaled at 1:1000 will include the location of

- a) Point of Connection
- b) All mainline and lateral piping (including sizes)
- c) Sprinklers heads
- d) All valves
- e) Main isolation
- f) Quick coupling
- g) Section isolation

Electrical Drawings

These drawings will include the location of:

- a) Point of connection
- b) Mainline and sub-main pipe
- c) Sectional Valve
- d) Power sources
- e) Route of Cable any Junction Box.
- f) Cable Joint

Manuals

Three sets of instruction manuals to be provided, a draft copy having been previously submitted for prior approval by the Engineer I/C .

These manuals are to be comprehensive and fully descriptive to enable the ENGINEER I/C to properly operate and maintain the system. They are to include a trouble-shooting guide of the problems likely to occur during the lifetime of the system. They must cover:

The irrigation control system operation and maintenance.

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All irrigation components installed including:

- a) Trade literature
- b) Local supplier details including:
- c) Name of company & contact person
- d) Phone number
- e) Local technical support
- f) Email id

Defects Rectification and Warranty obligations

The Defect Rectification and warranty obligations in the Conditions of Contract are applicable for the Irrigation System Works. In addition to that, the Contractor warrants the Water meter, Fully atomized Screen Filter, Pipes, Drip line, Sprinklers, Solenoid Valves, Cables and Irrigation Controller if any specified in this document.

Upon receipt of written notice from the Client of rejection of any irrigation material during the Establishment Period and / or the Defects Rectification Period due to its malfunctioning, the materials shall be promptly replaced with the same technical specification & make as originally installed.