CONSTITUTION GARDENS: THE MAKING OF URBAN PARK

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Constitution Gardens was conceived in 1973. The idea of the park was to provide the visitor with an escape from the bustle of the city and a place to sit beside the water. Paths wandered through groves of trees providing ever-changing vistas.

The prototype for Constitution Gardens was Hyde Park in London. While the Gardens were not to be as expansive as Hyde, they were to encompass 42 acres. A six acre lake was to be the principle focal point of this informal; urban park. Beds of azaleas and annual floral displays accented the park. A refreshment Kiosk was situated adjacent to the lake to further enhance the visitor experience.

History

During the mid to late 1800's, the site now known as Constitution Gardens was a tidal marsh of the Potomac River. Water depth was a foot or less throughout the marsh. Birds and other wildlife were the principal inhabitants. The northern edge of the marsh (today Constitution Avenue), was an extension of the Chesapeake and Ohio Canal, the eastern terminus of which was known as Tiber's Creek.

Most of this area, including the future sites for the Ellipse, Washington Monument Grounds, Lincoln and Jefferson Memorial sites and East and West Potomac Parks were all tidal marshes of the Potomac River. Evidence exists at the Ellipse that the area was a dumping ground for refuse and may in fact have been subjected to fires. At this site, where incinerated residue and bottles were noted in a soils study which was conducted in 1972.

In the late 1800's, the Army Corps of Engineers began dredging and reclamation efforts of the marshes, increasing the elevation of the area from about sea level to as much as 20-25 feet above seas level. This ended about 1915 when East Potomac Park (Hains Point) was completed.

This site, bordered by Constitution Avenue on the north, Henry Bacon Drive on the west, the Reflecting Pool on the south and 17th Street on the east was subjected to many different uses from 1910 to 1915. World War I "Temporary" Military facilities were constructed. These buildings served as the nerve center for much of the military activity during World Wars I and II. The Navy and Veteran's Administration occupied the site until 1969-1970, when the buildings were demolished. At this point, additional fill soil was obtained from the new Capitol Hill site for the Annex to the Library of Congress. These subsoil materials further raised the elevations and served to bury the support concrete pilings and basement structures for the old "temporary" buildings.

From 1970 to 1973, the site served as a major activity center for the National Folklife Festival. Numerous folklife demonstrations occurred on the western half of the site while the eastern half served as the principle parking area for visitors to the Festival.

Finally in 1973, the plans for Constitution Gardens, the Nation's Bicentennial Park, took shape. The site was to be transformed from an abused fill area into an informal landscaped urban park. Severe problems existed. The soils were very highly compacted subsoils from previous activities and were very low fertility. These soils were not suitable for the proposed extensive vegetative planting. Additionally, there were two diametrically opposed soil conditions: the first, high compaction, has been referred to , the second existed at the extreme western end of the site. These soils were basically the fertile soil mantle which had developed from weathering of the dredged materials. These were supporting a fine mixed aged stand of hardwood and softwood trees. This fact was important to the development of the Park.

In the first instance the soils were extremely compact, actually as dense or hard as concrete. There existed very little pore space for plant roots to penetrate. The soils would provide very little water: Water infiltration was low. Nutrients for plant growth were lacking, and there existed a rather high water table.

These basic physical and chemical characteristics existed at the central and eastern portions of the site. The extreme western location was composed basically of rich, fertile soils capable of supporting the proposed plantings.

Several soil modifications alternatives were presented to the Professionals designing the site. They were: 1) to purchase sufficient **quality** topsoil to form a mantle of soil capable of supporting the plant growth; 2) to plant the trees in modified planting holes using quality soil - i.e. the "tea-cup" effect; 3) to consider utilizing urban produced organic materials to amend the existing soil: namely composted sewage sludge (derived through the U.S.D.A. composting system), wood chips and aged leaf mold; or 4) to perform no soil modification and plant in the planting holes using the existing "soil".

The professional staff of the Park Service felt that with the advances made by the U.S.D.A. in composting, that alternative no. 3 was the best avenue of approach. These urban produced organic materials were to be blended with the existing "soils" of the site to produce the 18" soil mixture. The recycling of these organics was a very desirable alternative. Secondly, some of the favorable soils of the western end of the site were to be utilized on this blending operation to provide some supplemental topsoil material.

Involved with alternative no. 3 were two proposed soil amendment techniques which were dependent upon the type of planting materials used at individual sites. To the best of our knowledge this operation was one of the most extensive mixing and/or prepared soil mixes ever attempted. Several problems were encountered. Very heavy rains during much of the mixing operations hampered the achievement of the proper blend of materials. The sheer volume of materials and their inherent characteristics caused difficulty in the blending operation. (The most effective blending technique was the use of small tracked vehicle, the blade of which was tilted at an angle to the soil surface. These two problems were never really ever solved. Certainly the concept of this and other mixing operations are sound; however, the need for machinery to accomplish the task is very apparent.

Much of this kind of work tends to revolve around the topic of dollars and the overall economic picture of the operation. The final materials used versus the contracted estimates were quite close. The final total cost for the soil amendment phase of $205,584. This cost, when compared to the alternative costs for topsoil are quite interesting and noteworthy (Table 1).

Normally, where composted sewage sludge is utilized, there is concern over heavy metal additions to the soils. We feel that, in general, urban produced organic materials should be utilized within the urban system based on sheer economics and need. Certainly a significant fact is that most uses involving horticulture, landscaping and turf uses are sound because these materials are being utilized on non-food chain crops. Secondly, these "crops" are better able to tolerate any possible loading of heavy metals, etc. Similarly, by mixing these materials with other organics and soil materials (urban soils are noticeably poor soils to begin with) we are recycling them in perhaps the safest way possible back into the natural environment.

Sometime after the Gardens were planted, there was concern that methane gas might be produced from the use of organic materials. After very extensive monitoring we have located traces of methane, principally at the lowest elevations on the site. We have found traces of methane at soil depths of about 4-5 feet and some amounts bubbling through the lake bottom. It is possible that this production may result from the old marsh which was filled at the turn of the century.

Table 1
ITEMIZED COST ANALYSIS FOR 18" SOIL AMENDMENT PROCESS

ITEM	CUBIC YARDS	COST PER UNIT (COST YDS.)	TOTAL COST
Topsoil (on-site source)	2,700	2.85	$ 7,695.00
Purchased Soil	13,800	5.50	$ 75,900.00
Screened compost	1,313	3.00	$ 3,939.00
Leaf hauling (Park Service source)	5,040	3.00	$ 15,120.00
Unscreened compost	8,100	2.40	$ 23,490.00
Organic Mixing & spreading	36,000	1.20	$ 43,200.00
Leaf hauling (truck rental - 14 days)	600		$ 9,240.00
Wood chips (for replenishment of Beltsville Supply	6,750	4.00	$ 27,000.00
TOTAL			$ 205,584.00

20-20 Hindsight

There are several lessons top be learned from this prototype. The first is that it is virtually impossible to create a 100 year old garden in two years. The concept and realization of the concept will only become more of a reality with time: certainly the aesthetics of the site are appealing. The second lesson was to demonstrate the need for better mixing equipment for large soil volumes. The materials probably should have been mixed in lifts of 7 inches at a time rather than the full 14 inches. Thirdly, it would have been advantageous to incorporate the topsoil which was used into the mixture rather than layering it over the surface. The material tended to compact and create further problems. Similarly, a through drainage system should be planned for the design of any urban park.

Tree Plantings in Constitution Gardens

There are many pitfalls between the design concept and its successful implementation. In this section we will segregate Constitution Gardens into four planting zones to describe how the design concept was specially modified to suit the local site conditions in order to provide for successful plant growth. The Constitution Garden *in situ* status has just been described as being based on poorly drained, compacted, recently disturbed fill soils in the east end while the west end is comprised of weathered dredged materials that have not been disturbed for years and still support a broad perimeter of mature trees.

I. Open Space Trees

The basic planting scheme was to group trees in close intervals with the spacing between the trees such that at maturity the Garden would take on an informal forest-like character. Broad gaps were left between planting zones to provide vistas of the nearby Presidential Memorials, federal buildings and park areas.

In all, 1,186 trees were successfully installed during the initial planting in 1975 - 1976. Additional trees were planted but immediately removed from the site when they failed. These losses could be attributed to poor overwintering (many were healed in on-site) and transplanting shock when proper planting time was not possible because of delays in meshing site preparation with the planting schedule. Pressure to proceed, regardless of approved arboricultural practices, came from the political desirability of having the Gardens ready for the Bicentennial as per the approved timetable. Overall the tree planting was successful (particularly if one considers the site and planting schedules) with the survival statistics by species. At this point it would be worthwhile to analyze areas of greatest plant loss with the intent to provide accurate explanations for the loss and prescribe the remedies utilized to increase plant survival.

A. The heavy loss of *Cornus* species (80% loss), *Amelanchier* (26.5%) and *Chionanthus* (25%) can be attributed to a species adaptation difficulty when matched with stressful site conditions. Dogwoods are notoriously difficult to establish when not transplanted in the early spring. They also are an open shade-preferring species. Thus the trees planted at Constitution Gardens never had a decent chance to root into the site. They were exposed to open sun and particularly cold winters before the root systems ever really became established. In addition, many of the dogwoods were subject to poorly draining, wet site conditions described in subsequent sections. Symptomology was that of scorch and dehydration, or failure to foliate = all indicative of root system too insignificant to support the crown. Many of the dogwoods declined gradually. No primary fungal pathogen of significant borer problem was detected. Many shrub *Amelanchiers* and *Chionanthus* also declined gradually. However, under the site stress and poor establishment, stem canker and crown rot accompanied the decline taking out individual canes. These species have not been replaced as yet. The recommendations will call for group planting in raised and mulched beds as opposed to spot planting of individual trees. Such groupings will avoid the ever present threat of lawn mower damage and increase the opportunity for more rapid establishment. The trees would be planted in early spring. Selection of dogwood species will tend toward the hardier *Cornus kousa* and *Cornus mas.* In addition, substantive plantings are being held until sufficient canopy develops to provide some break from open site conditions.

B. Heaviest losses of trees occurred at what will be called the patio area at the eastern end of the Gardens (55% loss). This area was used as a staging zone for building the Garden. Thus it was most poorly modified in the soil building procedure, was planted last, was most highly compacted and perhaps as a result, contained several broadconcave, poorly drained areas. The punishing blow was a combination of sporadically heavy rains, deliberately intensive watering from the irrigating system intended to help establish turf, and leaks in the water system. All the above water, when released onto the compacted surface soil, puddled, ponded and moved where it might flow most freely. The path of least resistance almost always included the tree planting holes which contained the sand root balls from the nursery surrounded by the called-for mix of top soil. The so-called "tea-cup" syndrome resulted. Water filled the tree holes and could not drain out because of the clay compacted urban subsoils beneath the modified soil zone. The saturated soils in the planting holes allowed the trees to gradually sink in the holes so that most, if not all of the root system was enveloped in the saturated soils within the tree planting hole. Again the water could move out of the hole and usually more water moved to the tree holes from the given sources before they could drain. The healthier survival of trees in other areas of the Garden can be attributed to the effectiveness of the modified soil zone in providing sufficient drainage to prevent acute losses. Corrective actions taken at the patio area include reshaping the concave areas to a convex configuration, selecting more of the wet site tolerant species (swamp white oak, red maple, sweet gum), to some degree also improving drainage through the use of sod swales and calling for trees to be planted in holes pedestal style to avoid settling. Pedestal style planting consists of initially digging the tree hole to the depth of the base of the root ball such that the crown will set several inches (2" - 4") above the grade. The hole is then further deepened around the perimeter an additional 6 - 12 inch depth, thereby leaving the center or pedestal section intact. The bottom of the perimeter may be filled with coarse gravel to allow for drainage in the conventional manner.

There has been an unresolved discussion concerning whether the planting holes would be better backfilled with top soil or existing soil-topsoil to provide a better rooting medium, or existing soil to minimize the opportunity for tea-cupping.

C. The sporadic loss of other trees around the Garden tends to fall into the patterns previously described. Large transplanted trees (5" d.b.h.) such as the beech and many tulip poplars have never really grown into the site. The transplanting shock along with the continuing site stress conditions of exposure (winds, extremes of heat, cold, wet, dry) never permitted the trees to successfully establish themselves. As a result they gradually deteriorated, showing dieback, scorch, small leaves, etc. The recommendation here is to plant smaller trees with better care during the establishment period. Planting should be carried out in the spring.

Other trees have shown the effects of the tea-cup syndrome. In such cases, better planting techniques to maintain the crown several inches above grade, utilization of species tolerant of wet conditions and some site drainage techniques are being considered. It is understood that the urban soil conditions may at one time remain unduly wet through poor drainage while at other times stay excessively dry due to a lack of movement of capillary water from the lower soil profile and hydrophobic nature of dry, compacted soils. It is felt that in terms of site engineering it is more practical to rely on getting water to trees during dry periods as well as depending on established trees to survive dryness. Primary action is directed toward avoiding wet situations, which are more difficult to cure. To restate the above: urban soils can, during a give period, be either too wet or too dry. It is generally not possible to site design or select species which will handle both extremes. Best action then would be to handle the wet site through site drainage, planting technique and species selection. If the site should become dry, be prepared to water through some sort of watering system (sprinkler, soaker, tank truck, etc.). It is easier to get water to a dry site than get water away from a site once it is there. The greater risk of tree mortality comes from overly wet site conditions as opposed to dry periods once trees have become established.

Differences in survivability keyed to site conditions can be gleaned by analyzing tree loss data from the east and west portions of the Garden. Since the other environmental factors are constant, survival must be related to the soil conditions and influences of the existing trees in the west section. We might predict that survival rates closely parallel the overriding edaphic conditions.

II. Walkway Trees

The design concept for Constitution Gardens calls for an alignment of trees along the outer portion of the walkways. This string of beads effect is intended to emphasize the curving forms of the walkways while visually tying the park together. The 3 inch walkway surface of asphalt rolled with pea gravel is laid upon a heavily compact soil base about two feet in depth. The 328 Emerald Queen Norway maples were planted at grade and the three foot diameter holes backfilled with top soil. There was a sharp site dichotomy in the survival of these trees. Walkway tree loss was almost complete in the east end of the site (95% loss). Of course the compacted soils of the walkway base bottoming out into the impervious subsoils and construction fill of the site formed classic "tea-cup" situations. In the walkway there was not even the modified soil zone to allow some lateral water movement. Once water got into the tree holes, there it stayed, displacing air. The trees located in lower lying areas or in drainage patterns died first. As with the open space plantings, the availability of water was manifold. Heavy rains flowed across the compacted soil surface of the east end of the site with few trees or established turf to absorb the water. The water moved until it was absorbed by the sandier top soils of the walkway tree holes. Additional flows from the performing irrigation system occurred as well as from leaky valves, joints and broken sprinkler heads. Other water, which fell onto walkway surface, accumulated and eventually found its way into the tree holes, since the trees were planted at grade or gradually settled. The story at the west end of the Gardens is quite different (25% loss). Here the weathered soils, better established turf and large trees all acted to absorb most of the water before it reached the walkways. Also the bottoms of the tree holes extended into the better drained subsoils. Thus water would gradually move out of the tree holes into the surrounding soils. One section of walkway in the west end was built on an old Corps of Engineers dike which forms the southern border of the Garden, separating it from the Reflecting Pool. The walkway trees in this section fared little better than those of the east end, thus emphasizing the site constraints on tree survivability.

Several actions were taken to improve walkway tree survivability. First, the walkway locations near the lake level (unsuitable planting locations) were not scheduled for replanting. Second, the species was changed from the Norway maple clone to an upright Red maple clone (Red maples being more wet tolerant). Third, the trees were replanted with their crowns 2 - 3 inches above grade. The bottoms of the holes were filled with several inches of coarse gravel the new soil was tamped particularly well to minimize settling. Fourth, site drainage was improved to negate the movement of surface water. A site drainage system was installed parallel to the walkway sections, from the top of the patio parallel to the walkways to 17th Street. A trench was dug 3 ½ feet deep with at least six inches of coarse gravel laid in the bottom. A connecting line surrounded by gravel was then tapped in to the base of each tree hole. A perforated 6" plastic line was placed in the major trench and covered with more coarse gravel. Finally the remainder of the trench was filled with soil but left below grade such that the surface could be connected into a sod swale. The lower end of each trench line interconnected with a storm sewer line. There was positive water drainage out of each tree hole, in addition to a surface intercept system for surface waters. In some sections no storm line was available or surface runoff problems were felt to be minimal (particularly the west end). In these cases a sod swale 3 feet wide was installed parallel too the walkway. At the end of the firs year from planting date, none of 185 replanted trees were lost from water problems. There was twig and branch dieback from winter injury since the trees were planted in November and the winter was exceptionally severe.

III. Azalea/Rhododendron Beds

Thirteen azalea/rhododendron beds were planted throughout the Gardens. These beds were put in at grade with what might be called "run of the mill" top soil. Water simply was able to find its way to the more absorbing soils in the azalea/rhododendron beds and holes. The resulting wet heavy soil was the pitfall for most of the plants in these beds. The remedy to this condition was to improve the soil for azalea growing by increasing the sand, peat and perlite content: (Final mix: 25% sand, 50% topsoil, 12½% peat, 12½% perlite). This increased the drainage and maintained lower pH values. The beds were cleared and raised 18 – 24 " above grade with the synthesized soil mix. In addition sod swales were4 installed on the uphill sides of the beds to intercept runoff and divert it around the beds. The newly planted beds should do well with reasonable maintenance and growth of overstory trees.

IV. Turfed Areas

Little more need be stated about the turf areas. The soil modification to improve turf establishment has been described. The watering system which was installed provided adequate water initially but is not being used for turf areas anymore. Future turf management practices should include the application of ¼ to ½ " of screened compost (Beltsville or otherwise) spread over the site each year to maintain the organic matter content of the soil. In turn, this should allow for increased biological activity including worm action, should sustain the moisture holding capacity of the surface soils and should help resist compaction of the soils. Reseeding and aeration of heavily trafficked areas, particularly following construction of crowd gathering activities is expected.

In summation, Constitution Gardens should in many ways stand out as an example of urban site planting. Many of the very problems encountered in the effort to fulfill this large scale landscape design concept are the same ones which occur on smaller scales during street tree planting, landscaping the new house, or the larger industrial/government facility, etc. One cannot emphasize enough the necessity to incorporate into the planting plans/contracts, etc. the specific elements needed to effect successful planting. In the long run time, energy and funds will be saved through the judicious selection of plant materials, accurate analysis and accommodation of site conditions as well as timely, organized planting practices. In the case of Constitution Gardens the overriding problem was that of poor subsurface drainage. Specific actions were taken in each planting area to overcome this problem.