Urban Reforestation Site Assessment

The Urban Reforestation Site Assessment (URSA) is used to collect detailed information about planting site conditions. The URSA provides a tool to help organize important data to help determine where and what to plant, and what special methods are needed to prepare the site and reduce conflicts due to existing site constraints. The purpose of an URSA is to collect data at the most promising reforestation sites in an urban watershed, in order to develop detailed planting plans. The goal is to have all the available information about an individual planting area contained in a single form.

This writeup describes the URSA in detail. For more information on methods to select, screen, and prioritize candidate planting sites across a watershed or development site, consult Cappiella et al. (2005) and Cappiella et al. (2006).

Nine major elements are evaluated at each potential reforestation site to develop an effective planting strategy:

1. *General Site Information* **–** information about the location, property owner, and current land use at the site.

2. *Climate* – climate data, to help select tree and shrub species

3. *Topography* – local topographic features that may present planting difficulty

4. *Vegetation* – data on current vegetative cover, to determine if removal of vegetation is necessary and to select tree and shrub species

5. *Soils* – soil characteristics, to determine if soil amendments are needed, and to select appropriate tree and shrub species

6. *Hydrology* – site drainage, to determine if the site has capacity to provide water quality treatment of storm water runoff, and to select tree and shrub species most tolerant of the prevailing soil moisture regime

7. *Potential Planting Conflicts* – available space for planting and other limiting factors, to define specific planting locations, select tree and shrub species, or identify special methods to improve the growing environment.

8. *Planting and Maintenance Logistics* – logistical factors that may influence tree survival and future maintenance needs

9. *Site Sketch* – detailed sketch of the planting site

The URSA can be customized based on the needs and interest of the field crew. Not all elements will apply to every planting scenario, and each section of the field sheet may be adapted for the site.

The URSA is based on the assumption that planting potential at the candidate site is reasonably good. The URSA was developed based on several existing assessments listed in Table1. In addition, the URSA addresses specific urban planting conditions. One of these conditions, storm water runoff, is a factor that is frequently overlooked in urban reforestation projects.

Table 1. Resources Used in Creating the Urban Reforestation Site Assessment

Site Assessment Resource	Source
Cornell Urban Horticulture Institute's Site Assessment Checklist	Recommended Urban Trees: Site Assessment and Tree Selection for Stress Tolerance (Bassuk and others, 2003)
Site Assessment and Species Selection Worksheet	Recommended Trees for Vermont Communities (Chapin, 2001)
Soil and Site Indicator Scorecards for Connecticut Community Gardeners	Soil Quality and Site Assessment Cards (NRCS, 2002)
Checklist 1: Site Selection	Planting Trees in Designed and Built Community Landscapes: Checklists for Success (Reynolds and Ossenbruggen, 1999)
Chapter 3: Site Assessment	Reclaiming Vacant Lots (Haefner and others, 2002)
Section 7: Site Evaluation, Planting and Establishment	Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest buffers (Palone and Todd, 1998)
Appendix H: Planting Considerations and Erosion-Control Fabric	Integrated Streambank Protection Guidelines (WSAHGP, 2002)

Some simple desktop preparation is required before going out in the field to conduct the URSA. Fields shaded in gray on the URSA field sheet should be filled out in the office, including the general site information, USDA plant hardiness zone, regional forest association, stream order (if applicable), local ordinance setbacks, and party responsible for maintenance. The soil chemistry section, which is optional, should be completed after conducting the URSA, or when soil sample results are received. Field crews may also wish to create a simple field map for locating sites if they are planning to evaluate multiple sites in one day.

Staffing requirements for the URSA typically include a two-person field crew with some local knowledge of native and invasive plant species and basic forestry training. Knowledge of storm water management, soils, and hydrologic principles are also helpful, as well as prior experience in tree planting. The URSA can be conducted by local agency staff, or by trained watershed volunteers. It takes approximately 2 hours to complete the field form for each acre of proposed planting area if simple testing methods are used. The time spent at each site will vary depending on the type and size of the site. Up to 6 hours are needed to work up a detailed planting plan for each site back in the office. The URSA should be conducted during the growing season to better observe the growing conditions and existing vegetation. Equipment needed for the URSA is listed in Box 1; most can be obtained from forestry suppliers.

Box 1. Equipment Needed for the Urban Reforestation Site Assessment

- Field forms
- Writing utensils
- Field maps (optional)
- Tape measure
- Local plant identification books
- Invasive species identification resources
- Camera
- Spray paint or flagging
- Jugs of water and a watch (optional)
- Screwdriver or soil penetrometer
- Piece of rebar
- Small sledge hammer
- Shovel
- pH test kit
- Soil test kits (optional)
- Tennis or table tennis balls
- Soil auger

With the exception of the general site information, all sections of the URSA Field Sheet should be completed for the specific planting area, rather than for the entire property that contains the planting area. Instructions for completing each section of the field sheet are provided below.

General Site Information

In addition to completing the fields described below, field crews should photograph the planting area to record the site and anything of note as they complete the field sheet.

Location
Describe the site location, being as specific as possible, and using a consistent system for identifying planting sites. This may include noting the site address, nearest cross streets, GPS coordinates, page and grid of area map, subwatershed name, name of site, specific site identification, or all of these.

Property Owner
Note the name of the property owner. Contact the owner before conducting the field assessment, to obtain permission to access the site. Contact information may also be recorded here.

Current Land Use
Give a brief description of the general use or function of the site. Note if the site is currently under construction, and also list its intended future use, if known.

Climate

USDA Plant Hardiness Zone

Check the hardiness zone of the site using the USDA Plant Hardiness Zone Map available from the U.S. National Arboretum at www.usna.usda.gov/Hardzone/. Bassuk and others (2003) recommend regarding the site as one zone colder than listed if planting involves above-ground containers, because trees in containers are more susceptible to cold winter temperatures.

Sunlight Exposure

Evaluate the site to determine how much sun is received in the planting area during the growing season. This will determine what species can be planted there. Consider that a site has full sun if it receives more than 6 hours of direct sunlight. Partial sun means less than 6 hours of direct sun or filtered light for most of the day (as is common under a tree with fine textured leaves). A shady site receives little or no direct sunlight, or less than 6 hours of filtered light. Key elements to help determine sun exposure in the field are aspect and presence of structures that may block sunlight. For example, an east-facing planting area would receive morning sun (part sun), but if blocked by a nearby building would be considered shady.

Microclimate Features

Important microclimate factors to note include high wind exposure and excessive heat (re-reflected heat load). Signs of excessive wind include trees that are leaning or growing in the same direction, and plants with stunted growth on the wind-facing side. Sites that are commonly very windy include hilltop planting areas and urban sites where wind is funneled between tall buildings (e.g., wind tunnels). Reflected and reradiated heat loads from pavement, cars, buildings, and other urban surfaces can cause a tree to heat up and lose water at a faster-than-normal rate (Bassuk and others, 2003). These areas are typically south-facing, and on sunny days are noticeably warmer than nearby spots. If either of these microclimate factors exist in the planting area, tree species that are tolerant of drought must be chosen.

Topography

Steep Slopes

Note the presence of any steep slopes (typically defined as greater than 15%) and mark them on the site sketch. Steep slopes can make access difficult for planting and may require special planting techniques. Species planted on slopes should be more resistant to drought, as they will dry out faster. Also, special care should be taken not to disturb slopes during site preparation and planting, to prevent soil erosion.

Low-Lying Areas

Note the presence of any low-lying areas and mark them on the site sketch. Low-lying areas may be more evident during or after a rainfall since they collect water during storms. Trees can be planted in low-lying areas and used to treat storm water runoff, provided the species selected are tolerant of some standing water.

Vegetation

Regional Forest Association

Record the regional forest association, which indicates the climax or dominant species that characterize the types of plants found there. A useful source is a map of Küchler's Potential Natural Vegetation Groups, available from the USDA Forest Service at www.fs.fed.us/fire/fuelman/pnv.htm. Tree species that are dominant in a regional reference forest may be listed instead. This information is used to help select species of trees and shrubs to plant, particularly when the goal is to reforest an entire site.

Current Vegetative Cover

Note the type(s) of vegetation that are currently present in the planting area and the percent coverage, including turf, other herbaceous plants, trees, shrubs, or none. If any existing trees or shrubs are to be preserved, the species should be recorded on the field sheet. Note the presence and density (% coverage of the site) of all invasive plant species or noxious weeds present.

The current vegetative cover helps determine what type of vegetation removal or site preparation is needed before planting. Recording existing tree species at the planting area is also helpful to determine if the planting area is a good candidate for natural regeneration. Generally, any species located within 300 feet can be a seed source (Hairston-Strang, 2005). If existing trees and shrubs will be preserved, appropriate site preparation and planting techniques should be chosen to protect these trees. The type and density of invasive plant species will determine if control is necessary, and will help to select the type of control methods.

Adjacent Vegetative Cover

Note the dominant species present in any forest area adjacent to the planting area, if one exists. Also note the presence and density (percent coverage of the site) of invasive plant species or noxious weeds present adjacent to the planting area. Recording species present at an adjacent forested site gives an idea of what species might regenerate naturally over time due to the presence of a nearby seed source. Key things to look for include the presence of (1) light-seeded species (e.g., maple, sycamore, ash, pine, yellow poplar) upwind of the site (can be fairly far away), or (2) heavy-seeded species (e.g., oaks, hickories) upslope within 300 feet (Hairston-Strang, 2005). Presence of invasive plants adjacent to the planting area is usually an indicator that invasive plant control will be necessary at the planting site.

Soils

Soil characteristics, such as drainage, compaction, pH, and quality, should be evaluated at several sampling locations across the site, as characteristics of urban soils can vary greatly, even over a short distance. Record the findings for each sample location on the field form, check off the appropriate box based on the average condition, and record sample locations and results on the site sketch if results are highly variable.

Texture

Soil texture may be predominately sandy or clayey, or be a mixture of sand, silt, and clay, known as loam. Check the soil texture using the texture-by-feel technique and record the results. Sandy soils have a gritty feel and will not form a ball when moist. Clayey soils are sticky and plastic when moist, will form a strong ball resistant to breaking, and will provide a thin ribbon over 2 inches long. Identifying soil texture is important so that tree species that are tolerant of the soil texture may be chosen.

Drainage

Soil drainage can generally fall into one of three categories: poor, moderate, and excessive. To check drainage in the field, dig a hole 12 to 15 inches deep and remove a large handful of soil for examination. Soils with grey mottling or a foul odor indicate poor drainage. Other indicators of poor drainage include presence of plants that grow in poorly drained soils, and presence of low-lying areas that collect runoff.

To more accurately classify the site soil into one of the three drainage categories, dig a hole 12 inches deep and fill with water. Allow the water to drain completely, then refill the pit with water, and measure the depth of water in the pit. After 15 minutes, note the depth of water and calculate the rate of drainage in inches per hour. If water drainage is less than 1 inch per hour, the site is poorly drained. If drainage ranges from 1 to 6 inches per hour, soil drainage is considered moderate. If faster than 6 inches per hour, soil drainage is classified as excessive. Evaluating soil drainage is important so that tree species that are tolerant of the site drainage may be chosen.

Compaction

Soil compaction can be measured in one of several ways. The “screwdriver test” is the simplest and quickest method. Test the soil by inserting a screwdriver into the soil surface (this works best if done 2 days after a rainfall during the growing season). If the screwdriver goes into the soil easily, the soil has minimal or no compaction. If the screwdriver can be pushed into the soil, but requires some pressure, the soil is moderately compacted. If the screwdriver cannot be driven into the soil by hand, the soil is severely compacted.

The screwdriver test is useful in assessing surface compaction but may not detect deeper compacted layers, such as buried pavement, rubble, or compacted clay beneath the surface soil. Using a similar approach, it may be useful to test for subsurface soil compaction by using a 2- to 3-foot piece of 3/8-inch rebar and a small sledgehammer. In this way, the same qualitative evaluation can be made to a greater depth than is possible with the screwdriver test.

Another similar test is to dig a hole 2 feet deep with a shovel. The level of soil compaction is directly related to the difficulty encountered in digging the hole. For example, if the digging is easy, no compaction is present. If the digging is difficult or impossible, soils are severely compacted. A soil auger may also be used to test compaction. A dutch or Edelman auger is particularly useful for wet, clay, or heavily rooted soils.

More detailed tests of soil compaction include penetrometer readings and soil bulk density analysis. Because soil penetrometer readings are strongly related to soil moisture, penetrometer readings should be taken 24 hours after a hard rain (which may limit its utility during the URSA). At each sample site, record the average depth of penetration at which the probe measurement exceeds 300 pounds per square inch (Duiker, 2002). The most expensive but accurate test is to take soil cores and send them to a lab for analysis of bulk soil density. Evaluating soil compaction is important so that tree species that are tolerant of compaction may be chosen, soils can be amended before planting, or both.

pH

Test the soil pH at several spots in the planting area using a test kit, record the findings on the field form, and check off the appropriate box based on the average soil pH. If pH is highly variable, mark the sample locations and readings on the site sketch. Areas near buildings or pavement may test very alkaline due to building rubble so be sure to include these areas in the sampling if trees will be planted nearby. Rapid soil test kits for pH are available from county Cooperative Extension offices or home and garden centers. Evaluating soil pH is important so that tree species that are tolerant of the soil pH may be chosen.

Other Soil Features

Record any additional soil features of note, such as active or severe erosion, potential soil contamination, recent construction or soil disturbance, and debris or rubble in soil. If erosion is present, note the extent and severity of erosion, as well as the location and size of any rills, gullies, or soil slumping. Potential soil contamination may be indicated by the presence of drums containing hazardous or unidentified material; evidence of past dumping of restaurant waste, oil, construction debris or other materials; or unusual coloration of soil layers. Evidence of recent cuts or fills or recent construction activity includes buried trunk flares on existing trees, soil layers that are noticeably lighter in color than lower layers, absence of highly organic topsoil layer, and presence of newly paved surfaces or construction debris.

Presence of any of these soil features may indicate that some action is necessary to address impacts before planting. For example, erosion caused by excessive storm water runoff should be addressed by actions that eliminate the runoff source, or divert or infiltrate runoff at the site. If a site is suspected of contamination, further investigation should be conducted before proceeding with the project (e.g., research the site history, consult with landowner, conduct an environmental site assessment, pursue cleanup options). If soils are very disturbed amendments may be needed, or it may be necessary to bring in new soil.

Soil Chemistry (Optional)

The field crew may also want to test soil quality to determine specific nutrient, organic matter, and mineral deficiencies, or confirm soil contamination. Soil samples may be sent to a lab to be analyzed for organic matter content, salt content, and availability of key nutrients such as phosphorus, potassium, calcium, and magnesium. Soil quality testing need not be expensive—check with county Cooperative Extension offices to see if they provide low-cost or free soil testing. Alternatively, a visual assessment of soil quality can be made based on the condition of existing vegetation, presence of an organic topsoil layer, number of earthworms present, or other factors. Soil quality results should be recorded in the soil quality portion of the field form.

Hydrology

Site Hydrology

Note whether the planting area is an upland or riparian site. For riparian sites where planting is proposed on both stream banks, the hydrology section should be filled out separately for each bank. The blank space at the bottom of the hydrology section may be used to record data for the opposite bank.

Storm Water Runoff to Planting Site

Storm water flow to the planting site may be in a pipe or open channel, or be shallow concentrated flow or sheetflow. Note all the types of storm water runoff that flow to the planting site.

To determine if runoff bypasses the site in a pipe, look for storm sewer manholes, and follow their path (typically spaced at 200 foot to 400 intervals) to see where the runoff travels. For riparian areas, check for storm water pipe outfalls to the stream. Storm drain mapping from the local public works department may also be used to locate the storm sewers. To determine if an upslope drainage area discharges directly to a planting area, look for pipe outfalls to the site, and note the diameter of any pipe outfalls found (pipe size is related to the area drained). Walk around the entire planting area to look for open channels that direct flow around or across the planting area.

Runoff that is not contained in a pipe or open channel can either be shallow concentrated flow or sheetflow. Shallow concentrated flow typically forms when runoff travels over pervious surfaces greater than 150 feet, or impervious surfaces greater than 75 feet. Common indicators of shallow concentrated flow include rills, gullies, erosion, and sediment deposits. Sheetflow can only be maintained over about 150 feet of pervious surface or 75 feet of impervious surface before it starts to concentrate. These flow patterns are best observed at the site during a storm event.

Storm water runoff information is used to make decisions about whether and how to modify site drainage to treat storm water using trees or other methods, and to moderate the water balance at the site for trees and shrubs. The volume of storm water flow entering the planting area determines whether a site is currently at, under, or over its capacity to treat storm water runoff.

Contributing Flow Length

The contributing flow length is the longest distance over which runoff travels before it enters the planting area. For larger planting areas, it is the distance runoff travels before leaving the planting area, by entering an open channel, an inlet, or a different portion of the property. To measure the contributing flow length, walk a path from the point that is most hydraulically distant (typically the point on the farthest upgradient ridgeline) to the lowest point of entry to the planting area (or to the lowest point or outlet of larger planting areas). If conducting this assessment during a dry period, it may be helpful to use a tennis ball or a table tennis ball to determine which way runoff would flow by placing the ball on the ground at the farthest upgradient point and observing which direction it rolls. When walking the contributing flow length, note the slope and the dominant cover type. Sketch the contributing flow length on the URSA field sheet, marking any changes in land cover or slope along the way.

The contributing flow length is used to determine or verify if runoff to the planting site is sheetflow or shallow concentrated flow. If the contributing flow length is less than 75 feet over an impervious surface or less than 150 feet over a pervious surface, the runoff will likely remain as sheetflow and will not concentrate.

Floodplain Connection (Riparian Areas Only)

If the planting area is riparian, note the presence of levees or other structures that restrict flood flows onto the floodplain, and the bank height. The stream order will already have been recorded in the office but may be verified in the field. If desired, the depth to seasonal high water table can be measured using a soil auger and observing wetness, mottling, or gleying. Test pits or monitoring wells can also be used to measure depth to groundwater, if desired, but may be cost-prohibitive.

In urban areas, floodplains tend to be drier than their rural counterparts due to three factors: water table is lower due to reduced groundwater flows, floodplains are disconnected from their streams due to stream incision or construction of levees, and storm water runoff bypasses the buffer area by being piped directly to the stream. In these areas, upland species may be more suited to the hydrology of the site than floodplain species. Therefore, it is important to verify the hydrologic conditions at the site. In general, first order streams with bank height greater than 3 feet, and second order or higher streams with bank height greater than 5 feet, are likely to be disconnected from the floodplain (Schueler and Brown, 2004). Depth to groundwater is a good indicator of floodplain connection. The depth to seasonal high water table can be used as a general estimate of depth to groundwater, since groundwater elevations do not fluctuate substantially over the year (Palone and Todd, 1998).

Potential Planting Conflicts

This section is used to record the presence of potential planting conflicts at the site, in order to identify if site preparation or other special techniques are needed to reduce these conflicts and improve growing conditions for the trees.

Space Limitations
Note the presence of aboveground or belowground space limitations, such as overhead wires, pavement, structures, signs, lighting, existing trees, or underground utilities. Mark the location on the site sketch, and record the height of overhead wires, signs, and lighting. Utilities such as gas lines will often be marked (to warn people not to dig), while presence of electric and sewer lines may be less apparent. Look for manholes and sewer inlets to estimate location of sewers, consult the property owner, or estimate locations based on utility maps. Exact locations of utilities will be needed before site preparation and planting by calling the local department responsible for locating utilities (Miss Utility in the Mid-Atlantic) to mark their location at the site.

Presence of infrastructure may indicate that the use of alternative designs, materials, or maintenance practices are recommended to accommodate both trees and infrastructure without conflict. Existing infrastructure can limit the available space for planting, if setbacks are necessary to avoid future conflicts between trees and infrastructure as the trees mature. By recording the location of existing infrastructure and factoring in appropriate setbacks for trees (where applicable), a more accurate estimate of the area available for planting can be derived. Setbacks may be based on what is recommended by local utilities or required by local ordinance.

Other Limiting Factors
Record the presence of any other limiting factors such as these:

- Trash dumping and debris
- Deer, beaver, or other animal impacts
- Mowing conflicts
- Presence of wetlands
- Insects or disease
- Heavy pedestrian traffic

Record the type of trash present, its source (if known), and estimate how many truckloads are needed to remove it, to assist in planning cleanups. Note any evidence of impacts from deer, beavers, neighborhood pets, rodents, or other animals. This may include the presence of animal droppings, removal of bark on existing trees, or presence of nearby beaver dams. Impacts from deer are evidenced by sparse or nonexistent understory, a distinct browse line, or presence of nonpreferred browse species in existing or adjacent forests. Wetland indicators include the presence of wetland vegetation, poorly drained soils with grey mottling, foul odor, or standing water. If existing trees show evidence of disease or insect damage, record the type and extent of damage and the species affected. If heavy pedestrian traffic is evident, mark the location of pathways on the site sketch.

Other limiting factors will need to be addressed before planting. If trash dumping and debris is present, it will need to be removed. If animal impacts are present, methods to control populations or reduce their impact on trees should be evaluated. If the site is currently being mowed, provisions will be necessary to change the mowing practices after planting. This may include posting signs or using fencing or mulch to keep mowers far away from trees. If a wetland is suspected to be present at the site, it may be necessary to conduct a wetland delineation and obtain a permit before starting the project. This will also affect species selection for the site. In areas with heavy pedestrian traffic, the site should be designed to minimize impacts to trees, and may include use of mulch, fencing, or other protective measure.

Local Ordinance Setbacks
This section should be completed before going out in the field, to record setbacks between trees and infrastructure that are mandated by local ordinance or utility. Most setback requirements can be found in local ordinances related to site or subdivision development. Also check with local utility companies to determine their clearance requirements for different voltage wires. The purpose of this section is twofold: first, it ensures the designer complies with any required local setbacks; and, second, it allows analysis of required local setbacks to suggest changes to local ordinances to allow for better tree growth or incorporate more trees into the urban landscape.

Planting and Maintenance Logistics

Site Access
Indicate whether access to the site allows for delivery of planting materials, temporary storage of planting materials, room to maneuver heavy equipment, volunteer parking, and facilities for volunteers. This determines the methods and equipment to use in site preparation and planting. For example, if the site is not accessible by heavy equipment due to steep slopes, planting, soil amendments, and invasive plant removal will need to be done by hand. If volunteers will be used for planting, it is important to scope out facilities and parking ahead of time.

Water Source
Note the presence and type of any water sources. Sources may include rainfall, storm water runoff (indicated by shallow concentrated flow, sheetflow, or outfall to site in the Hydrology section of the field sheet), nearby hose hook-up (note distance from planting area), stream or overbank flow (in riparian areas), irrigation system, or nearby fire hydrant (work with local fire department to water trees). It is important to evaluate water sources since newly planted trees must be watered regularly the first year or two after planting. The existence of a nearby water source for irrigation makes this critical maintenance task much easier.

Party Responsible for Maintenance
The field crew should identify the land owner, local volunteer group, or homeowners association that is responsible for maintenance before going out to the site. It is important to designate up front the party responsible for maintaining the new plantings, to ensure that maintenance such as watering, mulching, weed control, removing tree shelters, and adjusting stakes will actually occur. The responsible party should be informed about proper maintenance techniques and the desired schedule.

Site Sketch

The field crew should quickly sketch the site, including the following features as a minimum:

- Property boundary, landmark features (e.g., roads, streams) and adjacent land use and cover
- Boundary and approximate dimensions of proposed planting area
- Variations in sun exposure, microclimate, and topography within planting area
- Current vegetative cover, location of trees to be preserved, and invasive species
- Location and results of soil samples (if variable)
- Flow paths to planting area and contributing flow length, location of outfalls
- Above or below ground space limitations (e.g., utilities, structures)
- Other limiting factors (e.g., trash dumping, pedestrian paths)
- Water source and access points
- Scale and north arrow

The site sketch will ultimately be the foundation for the more detailed planting plan.

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