St. Croix Roadside Tree Inventory and Management Strategies

Geographic Consulting, LLC

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Geographic Consulting
Natural Resource Management

St. Croix, U.S. Virgin Islands Roadside Tree Inventory and Management Strategies

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KEY FINDINGS

An inventory of the trees found in the right-of-way of all major roads of St. Croix was initiated in 2010 to determine the health and hazard potential of the roadside trees. Over two years, data on hazards, conflicts, height, diameter, disease and many physical growing conditions were collected on nearly 10,000 trees. A summary of the results can be found in Table 1.

TABLE 1:ST. CROIX, U.S. VIRGIN ISLANDS ROADSIDE TREE EVALUATION PROJECT SUMMARY

Summary of Roadside Tree Variables	Amount
Total Trees Inventoried	9,929
(private)	1883
(public)	8046
Potential Plantable Areas (miles)	83
Most Common Street Tree	Genip
% Trees Pavement Conflict	3.5%
% Trees with Utility Conflict	28%
Most Common Damage	Storm

Overall, we found many trees that were in conflict with utility infrastructure or that posed hazards to drivers. Most of these hazards could be alleviated by proper pruning practices. The tree population lacks diversity and is aging. Many areas would benefit from a well-designed tree planting using appropriate species, planted in the right place. These data are incorporated into the Recommended Roadside Tree Management Plan. This plan can be used as the cornerstone of applications seeking funding for proactive, preventative roadside tree maintenance action that will reduce power outages, lower costs, and beautify and diversify the roadside trees we see every day.

St. Croix's roadside trees are unusual, having many large trees, but few mid-sized trees. Large trees, such as Mahoganies (*Swietenia spp.*) were commonly planted in rows on roadsides many years ago, but today the young trees are primarily unplanned, 'wild' genips (*Melicoccus bijugatus*) and tibits (*Albizia lebbeck*).

FIGURE 1. FIELD CREW COLLECTING DATA ALONG THE ROADSIDE

Trees conflicting with utility lines cause widespread power outages, especially after storms. Tree pruning near power lines is expensive and difficult. Improper pruning practices lead to ugly trees that are even more likely to fail or cause additional problems. Vehicle strikes are also common, harming both trees and vehicles.

Proper planning puts the "Right Tree in the Right Place". Our data show that trees growing close to the road edge are less healthy because they are struck by cars and their roots are covered by pavement. Well planned roadside tree planting puts appropriate tree species away from the road edge and away from utility lines.

The preventative tree maintenance and roadside planting plan developed from this project will help appropriate agencies manage a valuable and beautiful resource while reducing inconvenience to utility customers and lowering the amount of necessary tree maintenance in the long term. Please visit the website below for additional updates and analysis as we form partnerships that utilize this valuable data.

INTRODUCTION

The island of St. Croix in the U.S. Virgin Islands is approximately 83 square miles, with more than 1300 miles of paved and unpaved roads. These roads traverse a topography that ranges from nearly 1200 feet at the top of Mt. Eagle to coastal roads at sea level (Brandeis & Oswalt, 2007).

It is often said that during the era of donkey carts a person could travel from one side of the island to the other under the shade of roadside trees (De Booy & Faris, 1918). However, the US Virgin Islands have undergone dramatic changes since those times, especially in the past 50 years. The human population has greatly increased, as has the number of cars on the road (Census, 2000). New homes and new roads have been constructed to accommodate these changes. Dirt roads and donkey cart paths that once connected sugar cane plantations to mills and markets have been modernized and expanded. A complex utility system of buried fiber optic cables and overhead electric and communication lines have been strung along these roads to reach nearly every residence. This new development has occurred quickly and in response to needs and perceived needs. These changes have generally occurred without a master plan.

FIGURE 2. A TURNIP-TAILED GECKO (THECADACTYLUS RAPICAUDA) IN THE ST. CROIX FOREST

Roadside trees on St. Croix have been part of the islands' heritage since the first roads were built. Roadside trees provide many services to the people of the Virgin Islands including shade, shelter, scenic beauty and habitat for wildlife.

Tree planting and management probably started with the Danish. One of the most spectacular and well documented examples of their tree planting efforts is the large mahogany stand at the entrance to Mahogany road near Frederiksted town. These enormous trees have given the scenic road its name and are thought to have been planted in the late 1700's (Weaver, 2006).

FIGURE 3: PLANTED MAHOGANIES IN FREDERIKSTED

Another documented roadside tree planting was conducted by the Civilian Conservation Corps (CCC) in the 1930's. This project is believed to be responsible for many of the Mahogany trees along centerline road (Weaver, 2006)

A roadside tree improvement program existed before 1967. In 1974, the Virgin Islands Forestry Division arose from this program (Bough, Forestry Today in the U.S. Virgin Islands, 1982). These programs planted more than 4000 trees along the roadsides before 1972 and were given the task of removal and management of the trees planted by the Danes and the CCC (Bough, The Virgin Islands Forestry Program, 1973). As in many urban and roadside plantings, these activities were poorly documented and not planned at an island-wide or area-wide scale.

Just as the human population and island infrastructure has changed dramatically over the past 100 years, so has the Virgin Islands' forest population. Land cleared for agriculture contains few trees resulting in the reduction in numbers and local range of many native tree species. New tree species were imported for their fruit and ornamental beauty. An even larger threat to native forests has been the introduction of aggressive weeds. These invasive species have become permanent members of the Virgin Islands forest community.

Roadside trees affect many facets of the island infrastructure including utility lines, utility poles, underground utilities, sidewalks, roads, and commercial buildings. Trees that are unmanaged and come into conflict with these infrastructure elements can cause expensive damage and outages. Unlike many trees in the U.S. mainland, trees in the tropics have a continuous growing cycle that is influenced more by water availability than winter dormancy

cycles (Daley, 2010). Management requires continuous maintenance, which can be quite costly. With the constant threat of high winds, saturated soils and flooding, especially during the hurricane season, it is of particular importance to have a strategy for managing trees that doesn't only involve response to damage but planning to prevent damage.

The importance of managing the roadside trees is not a new idea in the Virgin Islands. In 1983, the director of forestry for the U.S. Virgin Islands Division of Forestry listed several departmental priorities:

- Develop island-wide urban and forestry plans for all three Virgin Islands including inventory of existing roadside urban trees, parks, green spaces and particular needs.
- Plan the maintenance of existing trees, development of tree planting and removal guidelines, development of technical training programs for responsible agencies, individuals and civic groups in tree planting care, maintenance and removal.
- Develop an information and education program for the general public on the benefits of trees, including planting of trees and care for existing trees (USVI_VIDOA, 2010).

To date, these goals are being pursued through small scale projects funded by federal grants, local agencies and local non-profit groups. However, without a comprehensive guide for these activities, the overall goals are only being pursued in a piecemeal fashion. Further, without local comprehensive regulation for forests and trees and a lack of an urban or roadside inventory, accomplishing these goals remains difficult.

Although forest inventories and forest cover class programs exist for the Virgin Islands ((Brandeis & Oswalt, 2007; Daley, 2010; Kennaway, Helmer, Lefsky, Brandeis, & Sherrill, 2009; NOAA, 2011), none have focused specifically on gathering information on roadside trees for management purposes. The goal of this project was to assess the status of the roadside trees of St. Croix and then develop a general strategy for their management. This strategy must consider both health of the trees and human safety making it necessary to first determine the current status of the roadside trees and the capacity of the various agencies. This document presents the results of the roadside tree assessment conducted by Geographic Consulting and the strategies developed from this assessment to begin the process of better managing the roadside trees of St. Croix.

METHODS

FIELD DATA COLLECTION

The roadside tree hazard assessment of the major roads of St. Croix was developed to accomplish three goals.

- Develop an inventory of roadside trees on St. Croix, U.S. Virgin Islands
- Assess the current health of roadside trees on St. Croix
- Identify individual hazardous trees and targets

A full inventory along the major roads was identified as the only viable method to accomplish these three goals. Other studies have used a random plot design to assess roadside tree conditions and trends (Cumming, Twardus, & Smith, 2006; Cumming, Galvin, Rabaglia, Cumming, & Twardus, 2001; Cumming, Nowak, Twardus, Hoen, Mielke, & Rideout, 2007). Although adequate for describing trends, a random plot design cannot provide the tree by tree descriptions that are necessary for guiding public organizations' management of individual roadside trees.

The roadside tree inventory and hazard analysis survey area included the major roadsides identified in the USGS 1994 topological survey (Figure 4). Approximately 150 miles of roadsides classified as "major roads" were identified on these data layers. The roadsides pass through U.S. Census block areas of rural (<0.78 people per acre) and urbanizing (>0.78 people per acre (Census, 2000) although each island is officially designated as a rural county.

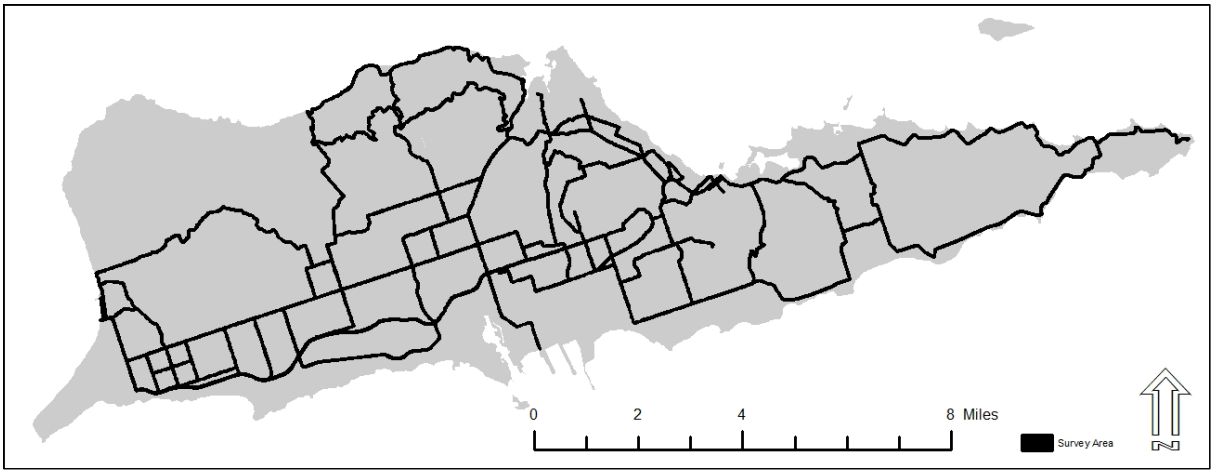


FIGURE 4: PRIMARY ROADS WITH TREE INVENTORY AND ASSESSED FOR TREE HAZARD

A total area of 909 acres (368 ha) was surveyed. The survey was conducted on each side of the road and extended to approximately 25' (8m) from the road's edge. Data was collected within this area to encompass utilities located in the Rights-Of-Way (ROW). Within the survey area, all public trees greater than 4" diameter at breast height (DBH) were identified and analyzed. Private trees were also inventoried, but a smaller subset of variables was collected because data collectors did not attempt entry to private property during this project.

FIGURE 5: DATA COLLECTION ON THE ROADSIDE

Data collection occurred over a 19 month period, from June 1, 2010 through December 21, 2011. A trained crew of 2-3 people walked or drove along each of the major roads collecting the applicable data for each individual tree or treeline. Data forms developed by Geographic Consulting for the software Trimble Terrayne™ were uploaded on Trimble Juno™ units for data collection. Trimble Pathfinder Geoxhs ™ were used to record the exact location of each tree and the associated tree assessment.

FIGURE 6: FIELD DATA COLLECTION TOOLS

Data collection crews were trained in tree identification, equipment use, safety protocol, data collection protocol and trained as ISA certified arborists for health and hazard classification.

All collected data fell into one of the following major categories: physical species characteristics, proximity or conflict with utilities and targets, health classification, hazard classification and general recommendations (see Appendix E for list of specific data collected).

Heights and distances were measured using laser range finders (Laser Technology, TruePulse 200 ™) and tree diameter at breast height (dbh) was measured using dbh tapes.

All roadside vegetation was classified into one of four categories.

- **ROW Tree**: Defined as individual trees located within the observed ROW up to 25' from the road's edge. Observable ROW included fence lines, observed property lines and mowed areas in which trees were not managed by the adjacent property owner.

- **Private Trees** – Defined as trees located within 25' of the road's edge, but clearly identified as belonging to a private owner, usually because they were behind a fence. Limited data were collected on these trees including: species characteristics, height, general health and location.

- **Roadside Vegetation Line**: Defined as a line of roadside trees in which management or even identification of individual trees was impractical. Along vegetation lines, multiple trees were generally managed together, rather than individually. Data collected along vegetation lines included: a description of the major overstory and understory, distance to road and hazard presence. Tree lines tended to be managed by "side-cutter" mowers and were generally comprised of dense stands of tan-tan (*Leucaena leucocephala*) or genip (*Meliococus bijugatus*)

- **Points of Interest**: Defined as any point that may relate to tree-utility interaction or other relevant points. This included dead trees, stumps, utility poles, culverts, rare small trees, utility line slumps, etc.

ANALYSIS

Patterns of the current condition of roadside trees were described and analyzed. Tree data were analyzed in relation to other available GIS data such as soils, land classification datasets, elevation, slope and aspect. Patterns in the health and hazard potential were also examined to find associations between these characteristics and species metrics.

ROADSIDE INVENTORY

Data collection on the major 143.5 miles (287 ROW miles, 870 acres) of roadsides of St. Croix resulted in the assessment of 9919 trees for descriptive characteristics.

6907 Public Trees
1205 Line Trees
1817 Private trees

COMPOSITION OF ST. CROIX STREET TREE POPULATION

A total of 9704 trees were assessed for species metrics, 8512 assessed for conflict and health and 6746 trees for hazards. 36 families, 78 genera and 108 species were identified. Trees belonging to the 10 most common families accounted for 90.5% of all the trees surveyed (Table 3) and trees belonging to the 10 most common genera accounted for 81% of the total (Table 2). The lack of diversity is striking at any taxonomic level.

TABLE 2:TEN MOST COMMON GENERA OF THE ROADSIDE TREE POPULATION ON ST. CROIX

Genus	%Total
Melicoccus	29%
Swietenia	21%
Albizia	11%
Tamarindus	5%
Delonix	4%
Cocos	3%
Mangifera	2%
Bursera	2%
Andira	2%
Samanea	2%

TABLE 3: TEN MOST COMMON TREE FAMILIES OF THE ROADSIDE TREE POPULATION ON ST. CROIX

Family	%Total
Sapindaceae	29%
Fabaceae	25%
Meliaceae	22%
Arecaceae	4%
Anacardiaceae	4%
Burseraceae	2%
Bignoniaceae	2%
Nyctaginaceae	1%
Casuarinaceae	1%
Boraginaceae	0.46%

St. Croix's roadside tree population is overwhelmingly dominated by three species of trees; Genip (*Melicoccus bijugatus*), West Indian mahogany (*Swietenia mahogani*) and Tibit or Mother in Laws Tongue (*Albizia lebbeck*), which together, comprise 56% of the roadside tree population.

TABLE 4: TEN MOST COMMON GENERA OF THE ROADSIDE TREE POPULATION

Species	Common Name	%Total	Mean DBH (cm)
Melicoccus bijugatus	genip	29%	32
Swietenia mahagoni	West Indian mahogany	16%	66
Albizia lebbeck	tibit	11%	35
Tamarindus indica	tamarind	5%	53
Delonix regia	flamboyant	4%	41
Cocos nucifera	coconut palm	3%	24
Mangifera indica	mango	2%	47
Bursera simaruba	turpentine	2%	39
Andira inermis	dog almond	2%	33
Swietenia macrophylla	Honduras mahogany	2%	68

Age was not measured directly, but DBH is an accepted proxy measure of age for most species. Genip (M. bijugatis) has the lowest average DBH of the common tree species. This likely signifies that these trees tend to be younger than other species and represent the future. The next seven most common species make up only 20% of the total population and combined, do not equal the number of genip (Table 4).

We used standard U.S. Forest Service diameter classes to describe the distribution of tree size and by proxy, tree age (Figure 4). Results indicate that the population consists of a large young class and a large older class of trees. Medium aged trees are prevalent in the population.

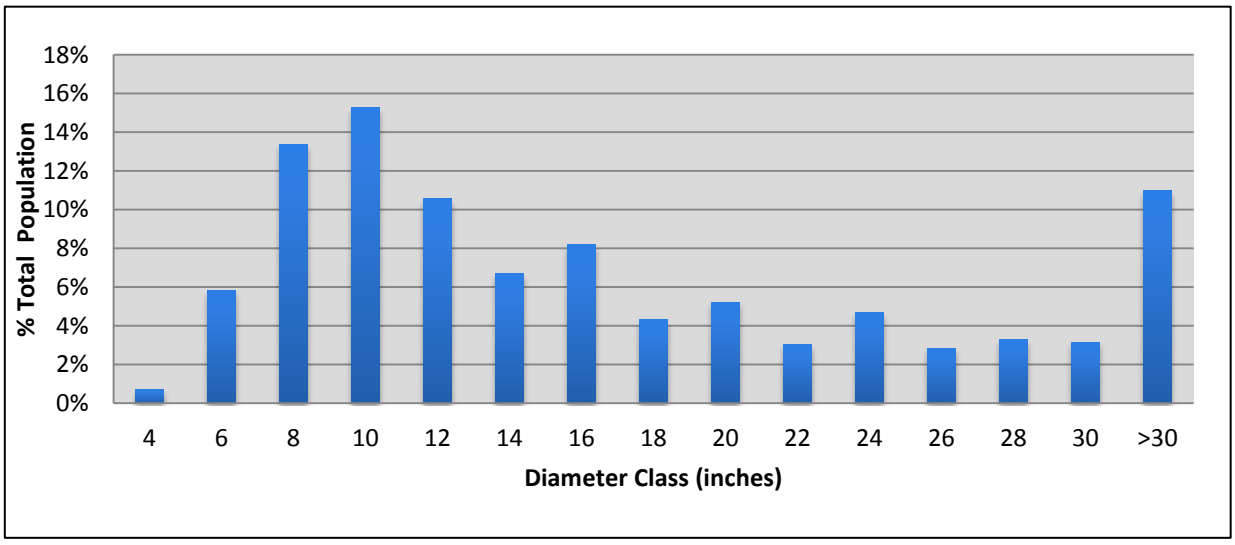


FIGURE 4: ST. CROIX, U.S. VIRGIN ISLANDS DIAMETER CLASS DISTRIBUTION (4->30" DBH IN.) -2011

When the data distribution is limited to five distinct diameter classes to simplify management, a slightly different pattern emerges. In this case, there are the most trees by far in the smallest class, the middle three size classes are smaller and very similar to each other and only a small number of trees fall into the largest diameter class (Figure 5).

Size classes were also examined by species (Figure 5). Genip, tibit, dog almond (*Andira inermis*) and coconut (*Cocos nucifera*) represent the young, small-diameter trees, while mahogany trees tend to be much older but lack an up and coming cohort. 43% of all of the trees in the 4-12" DBH class are genip. Nearly 50% of trees in the largest size class are West Indian mahogany. In short, the total population is essentially dominated by a young genip and an aging mahogany population.

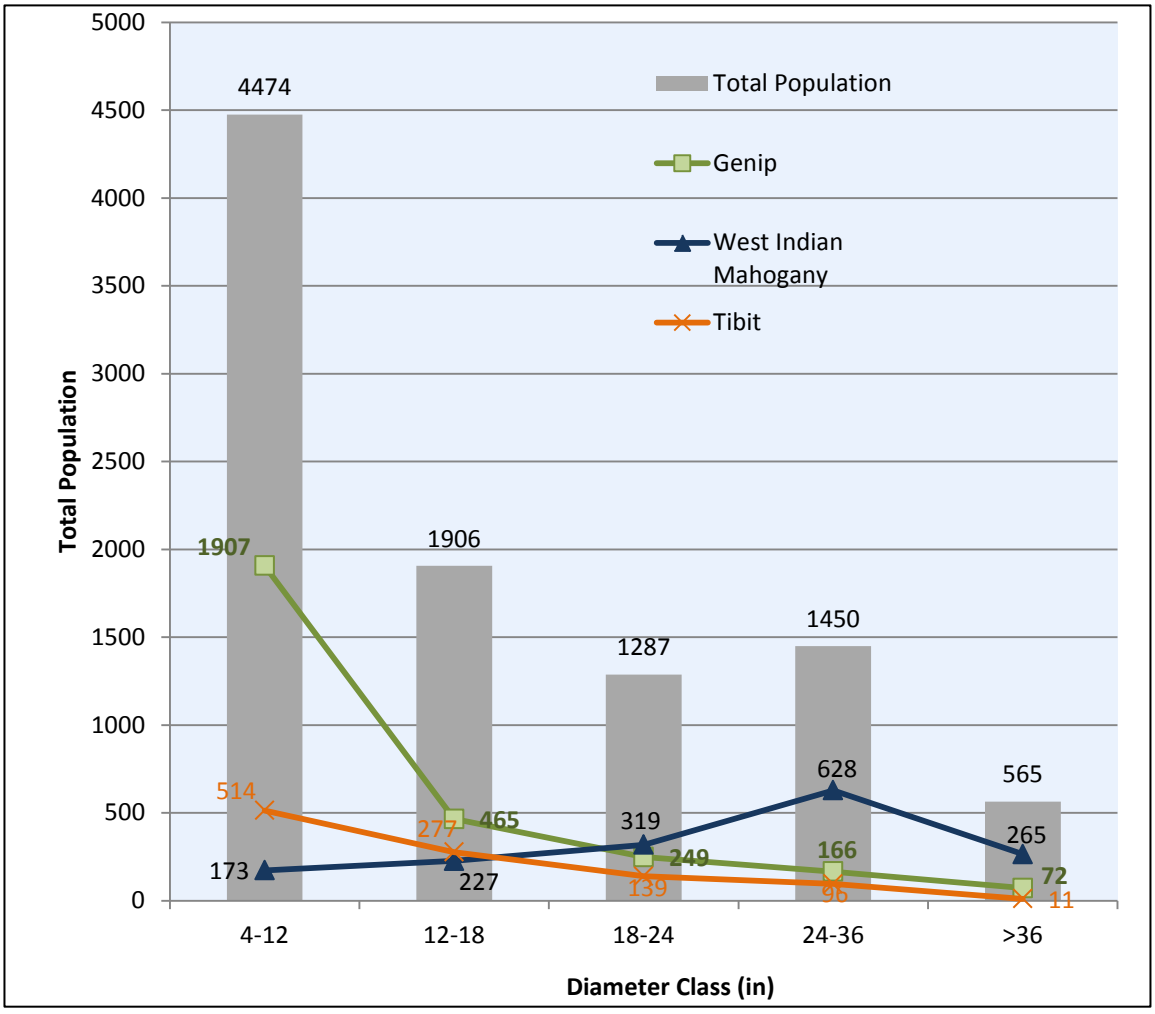


FIGURE 5: DIAMETER CLASS DISTRIBUTION OF ST. CROIX ROADSIDE TREES (4-12,18, 24,36,>36 IN.)

TREE HEALTH ASSESSMENT

Trees were assessed using a variety of indicators of general health and given a final health score based on the combination of the indicators (Figure 7). These health scores indicate that overall, the population is in medium health with 1% of the total population in very high health and 4% of the population with a very low health score.

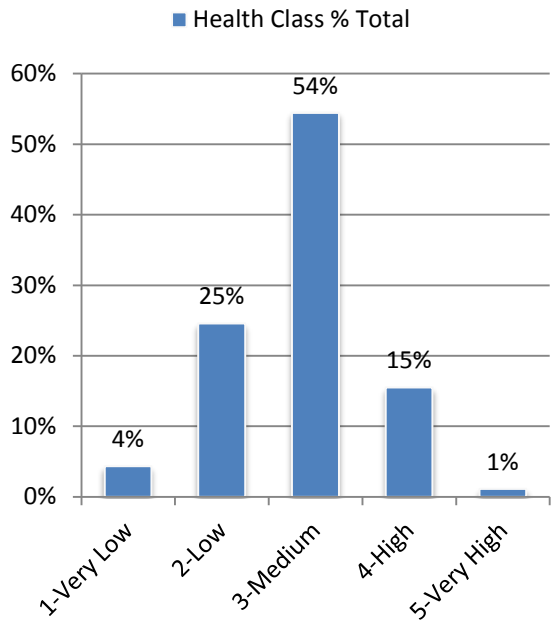


FIGURE 7: ROADSIDE TREE HEALTH CLASSIFICATION

FIGURE 8: TOPPED TREES FOR LINE PRUNING

Tree damage was assessed separately by crown, trunk and roots. We also identified the cause of the damage when possible and noted tree defects such as shaded out trees, included bark and co-dominant stems. For the rapid assessment, damage was noted as primary and secondary. 93% of all trees assessed had some form of crown damage, 67% were observed with trunk damage and 45% were observed with root damage.

Crown Damage -The majority of crown damage was attributed to storms (53%). Other sources of damage included disease (5%), pruning (19%), vehicles (7%) and other (9%).

FIGURE 9. TRUNK DAMAGE, MOST LIKELY CAUSED BY A VEHICLE

Trunk Damage - Observed trunk damage was fairly evenly distributed between different sources: storm (22%), vehicle (23%), fencing (13%), machete (18%), weed eater (4%) and other (18%). The "other" category for trunk damage included co-dominant stems and included bark.

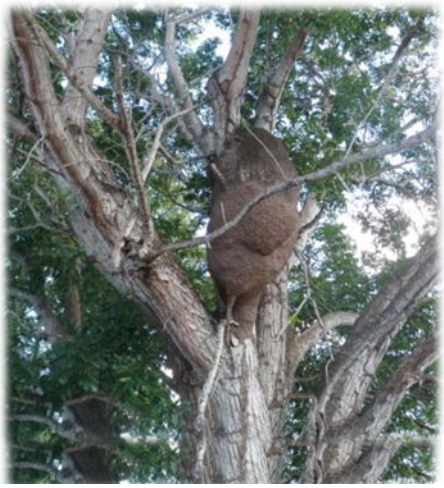


FIGURE 10. GANODERMA (ABOVE) AND A TERMITE MOUND (BELOW)

Root Damage – Although difficult to observe, root damage was dominated by road cleaning activities (43%). Many trees along the roadside had exposed top roots, small roots in the exposed soils and were continuously scraped by tractors to clean the roadside. Other damages included disease (3%), other (20%), parking (9%), and road paving (28%). Each damage class was rated on a five point scale from very low to very high and combined to create average damage and health. Results from the root damage were limited due to the limitations on observation.

Disease signs/symptoms were mostly associated with termite nest activities (Figure 9). Major disease associated with root rot was ganoderma (Ganoderma zonatum). Black sooty mold, thrips, scales were other diseases observed.

Among the ten most abundant species, we observed generally medium health scores with some variation between species. Scores were scaled from 1-100, in which a score of 1 would indicate an extremely unhealthy tree and a score of 100 would indicate a tree with no health issues at all. Genip, flamboyant, tibit and dog almond received scores in the low 50s. The two long lived species of mahogany received the highest scores of the common species with both scoring in the 60s (Table 5).

TABLE 5. HEALTH RATINGS FOR THE TEN MOST COMMON TREE SPECIES

Species	Common	Heath Rating
Melicoccus bijugatus	genip	55
Swietenia mahagoni	West Indian mahogany	58
Albizia lebbeck	tibit	52
Tamarindus indica	tamarind	59
Delonix regia	flamboyant	53
Bursera simaruba	turpentine	59
Andira inermis	dog almond	52
Mangifera indica	mango	52
Swietenia macrophylla	Honduras mahogany	66
Swietenia Jacq.	Mahogany hybrid	63

Not surprisingly, trees that were closer to the road, on average, were in poorer overall health than those that were farther from the road. (Figure 11).

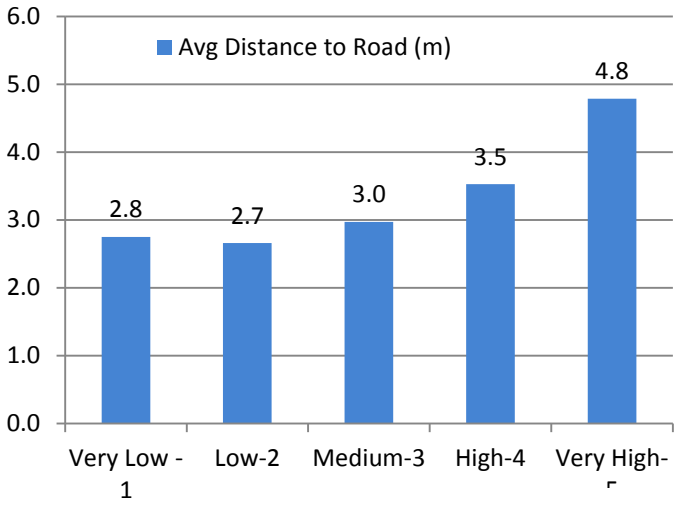


FIGURE 11. AVERAGE HEALTH SCORE OF ROADSIDE TREES IN RELATION TO DISTANCE FROM ROAD

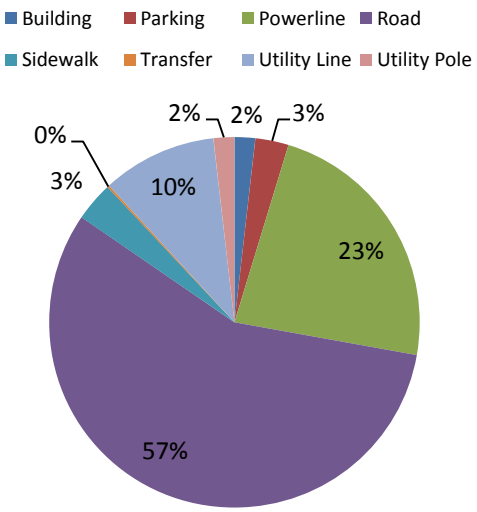
HAZARDOUS ROADSIDE TREES

Public trees were rapidly assessed for possible hazard potential, failure ratings and their targets. 87% of the public trees posed some sort of risk to their surrounding area and objects. By definition, for a tree to pose a hazard it must have both a defect and a target.

Trees were given a hazard rating on a scale from very low to very high, for each section of tree (crown, trunk, roots). The most frequently observed potential failure area was in the crown and was usually due to dead limbs, included primary limbs and buckling. Trunk potential was associated with co-dominant trunks with included bark or cracks and root failure potential was associated with hollow and rotted limbs (Table 6).

TABLE 6: AVERAGE FAILURE POTENTIAL FOR EACH SECTION OF TREE

Potential Failure Area	%Total	Average Rating (1-5)
CROWN	67%	2.9
ROOTS	3%	3.4
TRUNK	18%	3.6



When a tree was identified with hazard potential, the targets were identified for each tree. The most common target was the road itself followed by power lines. Other targets included buildings, parking areas, sidewalks, transformers, utility lines and utility poles (Figure 12).

Trees that are making direct contact with a target are considered “in conflict” with the target. 1932 trees were in conflict with utilities and 245 trees were in conflict with pavement making up 27% of the public trees surveyed.

ROADSIDE TREES MANAGEMENT STRATEGIES

The current condition of the roadside trees on St. Croix has resulted from a situation where there is no single management strategy for the roadside system yet several entities are actively managing trees on a daily basis. Proper management of this valuable natural resource along roadsides requires maintaining a balance between the health of the tree and the potential for interference with elements of societal infrastructure. Managing roadside trees is inherently challenging. The place where trees, utilities roads and people all converge is dynamic, busy and involves many competing interests.

CURRENT CONDITION

The current condition of the vegetation on St. Croix's roadsides is the result of multiple management practices, by several entities over several hundred years that were not coordinated. Much of the management or maintenance is "single purpose" pruning aimed at clearing roadways and/or utilities, with little consideration of the long term management or health of the tree.

The following are the major stakeholders involved in roadside tree management:

VIRGIN ISLANDS PUBLIC WORKS (VIPW) maintains roadside vegetation and ensures access to utilities and safety to motorists and the general public. Some of the work is done by VIPW employees, but most of the work is completed by contractors. For example, contractors clear roadside vegetation to clear driver's line-of-site using side cutting, boom mowers on tractors. This typically extends to about 4-5' from the edge of the road and eliminates most new growth. Machetes and weed eaters may be used for finer work, depending on the contractor. Tree removal, higher tree work, tree pruning around utilities and similar activity through VIPW is normally contracted to ASPLUNDH.

THE VIRGIN ISLANDS WATER AND POWER AUTHORITY (WAPA) is responsible for installing and maintaining water lines and aboveground and belowground electric lines. The majority of WAPA's tree work involves addressing conflicts with the utilities. WAPA has at least one tree pruning truck, but much of their tree work is completed by ASPLUNDH.

ASPLUNDH is a national chain of tree care professionals hired by both WAPA and VI Public Works. The quality of their work in the Virgin Islands is noticeably lower than what is considered acceptable in the mainland US (ASPLUNDH, 2008).

INNOVATIVE manages utility lines for telephone and cable as well as buried fiber optic cables. The majority of the conflicts they experience with trees are at the individual drop line at private homes and they do very little roadside tree work to clear lines.

THE GENERAL PUBLIC contacts various agencies with a wide range of concerns, from requests to remove trees in order to restore power to requests to preserve trees they consider important. There is considerable confusion among the general public about who is in charge of what and what the rules are. The Department of Agriculture and University of the Virgin Islands frequently receive calls about roadside trees from the public, even though those agencies have no jurisdiction or mandate to do roadside tree work.

MANAGEMENT STRATEGIES

Based on the hazard assessment of the roadside trees of St. Croix, the following strategies were developed for proper management of the roadside trees for both human safety and healthy trees.

1. High priority removals of the most hazardous trees.
2. Roadside tree planting plan that puts the right tree in the right place
3. Proactive, coordinated **and** regular tree maintenance that includes storm preparedness
4. Creation and implementation of a tree law for the Virgin Islands that defines responsibilities and appropriate actions to manage roadside and other public trees.

1. HAZARD TREE REMOVAL

The goal is to reduce the current level of risk trees pose to the general public, utilities and other infrastructure. The strategy for accomplishing this is to identify the most hazardous trees in the roadside tree population and mitigate this risk through tree removal, major pruning or other appropriate management activity. During the data collection portion of this project every roadside tree along the

main roads was individually assessed for their hazard level. See the results section of this document for details on the types of hazards and targets found on St. Croix's roadsides. Results from the hazard tree assessment produced a picture of a roadside forest in need of attention. Most trees need some form of major pruning, which is not economically viable.

The trees identified in this section of the management plan have the greatest need for immediate correction including removal or major pruning. They are identified on the map in Figure 13. These trees include;

120 Trees with major defects, very poor health and disease that should be immediately removed (44 Dead)
60 Trees in need of a major prune to mitigate hazardous conditions.
54 Trees that should be replaced with new plantings
76 Additional dead trees to be removed

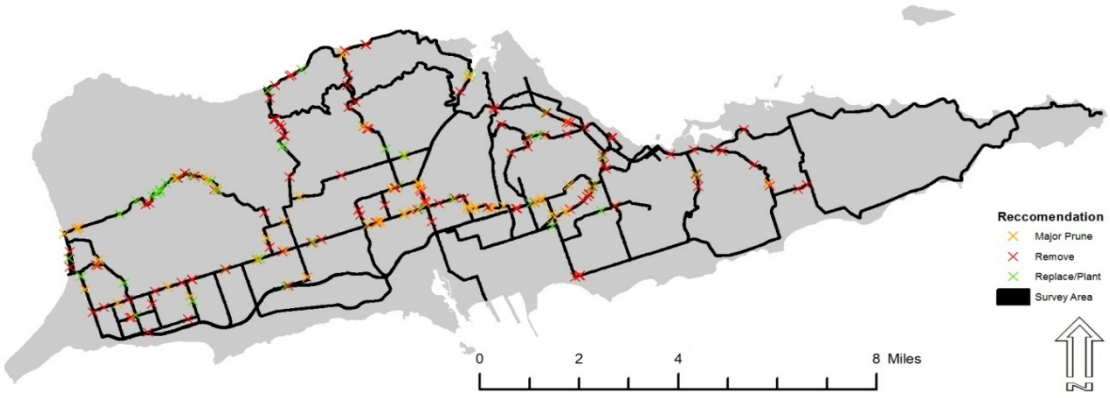


FIGURE 13: ST. CROIX U.S. VIRGIN ISLANDS PRIORITY ACTION MAP

Trees designated for immediate removal have both low health and are a high risk. The risk usually involves the potential for a large branch or the entire tree to fall onto a target, such as a utility, building, road or other target. These trees cannot be corrected or made safe through pruning. They are the trees most likely to fail in the short term and also at the greatest risk among the 9,929 trees in the study to fall during a storm. Removing these trees should be considered proactive storm preparation through management.

2. ROADSIDE TREE PLANTING

The goal for future trees on roadsides in the US Virgin Islands should be to have a healthier and more diverse tree population that poses less risk to the public, causes fewer utility conflicts and costs less to maintain. The strategy for achieving this goal is to create and execute a thoughtful roadside tree planting plan that concentrates on putting the right tree in the right place.

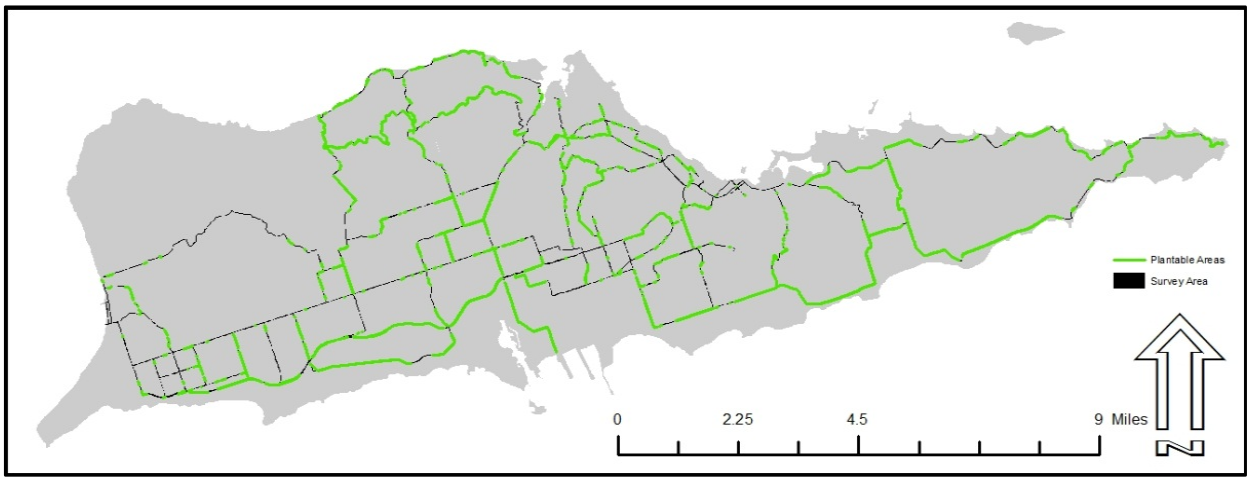


FIGURE 15. PLANTABLE AREAS MAP

FIGURE 14. PLANTABLE AREAS EXAMPLE ALONG AIRPORT ROAD

It is essential to have this part of the roadside management plan in place during the time that the hazard tree removal begins. Many members of the general public have strong reactions against any type of tree removal. Even if the tree is in poor health, in an inappropriate location and is causing problems there may be people who want to protect it. Having a highly

visible tree planting program in place at the time of tree removal project lets the public know there is a larger plan with the goal of caring for roadside trees

The first step in proper roadside tree planting is choosing a location where the tree will have soil, water, light and space to achieve its full adult height. Trees should be installed a minimum 12', but preferably 15' from the road edge and at least 6' from any other hard infrastructure such as a wall, fence, building or parking. Geographic Consulting identified many tree planting opportunities along 83 miles of roadway (Figure 14,15).

One needs to know the adult height of a tree before planting it. Plans to install large trees in small areas and prune them regularly are plans doomed to failure before they even start. A roadside tree planting plan must be low-maintenance by design and the inclusion of trees that require constant pruning is in direct conflict with this concept. Planting trees that are unlikely to come in conflict with any infrastructure will reduce outages, damage and perhaps most importantly, will reduce the cost of fixing damage or constantly maintain the tree. Given the great variety of trees available in the Virgin Islands', there is no reason to plant the wrong tree in the wrong area.

Proper tree planting techniques ensure that once the carefully selected tree is installed in the appropriate place that it has the best chance to survive. ANSI (ANSI, 2005; ANSI, 2006; ANSI, 2011; ANSI, 2006) and ISA make recommendations for how to best plant roadside trees. We have simplified some of these recommendations into a single sheet and offer it here as a guide to how to plant a roadside tree in the US Virgin Islands. (Appendix D). The vast majority of the recommended species are native to the US Virgin Islands. For the convenience of those that are not familiar with these tree species, they are divided into two groups, "Talls and Smalls". Maximum heights and other characteristics are provided for all species. This way one can easily select a tree of the appropriate size for the planting area, local soil, moisture and other conditions.

3. ROUTINE PRUNING AND MAINTENANCE

Proper maintenance of roadside trees is essential to reducing the potential hazards that trees can create on the side of the road. The previous section addresses the strategy of minimizing or eliminating the need for maintenance by planting appropriate trees given the roadside conditions. But many trees already exist that require regular and proper maintenance.

Current roadside vegetation and tree management practices are not coordinated by any one agency. As a result there are no consistent priorities, nor are there annual goals or a way of measuring whether or not those goals were accomplished.

With several different agencies maintaining the same trees, but with different objectives, conflicts will inevitably arise. The very same tree may be pruned by three different crews hired by different agencies. Coordination between agencies will not only reduce the amount of redundancy in tree pruning and thus reduce costs, it will also ensure that one agency's tree maintenance work does not create more work for the others'.

Proper pruning techniques are also a key component of roadside tree maintenance and all maintenance crews should have at least some basic arborist training. For example, 307 of the trees previously pruned were topped, an inefficient method of pruning that does not prevent the tree from growing leaders back into the target. With the proper training, crews could greatly reduce their work load and the need for repeated visits to the same tree.

Roadside tree maintenance should be treated slightly differently depending on the actual location of the tree. Although there is some overlap between the groups, most trees will fall into one of three categories for maintenance:

1. LINE MAINTENANCE - Currently trees and vegetation are topped and cleared out of existing lines and sprouts commonly grow back into the obstruction. A priority list from initial data collection has identified 27% of the trees interact with power and utility lines to varying degrees. A vigorous five year pruning schedule focused on replacement and crown thinning could reduce and slow this interaction.

2. TOWN AND NEIGHBORHOOD MAINTENANCE – Urban management, especially in towns and neighborhoods takes into consideration the heritage, structure and look of the individual

tree with regard to the surrounding landscape. All of St. Croix is classified as rural by the U.S. Census, but it does have four distinct town centers in Frederiksted, Kingshill, Sunny Isle and Christiansted. Trees occurring in these town centers require an individual maintenance approach due to the increased danger posed by these trees. These high population density areas can be grouped into regions and each region can receive attention on a rotating basis.

3. RURAL AND AGRICULTURAL AREAS – Generally rural roadside vegetation and urban roadside trees and vegetation are managed differently. Rural areas don't generally manage individual trees but try to maintain a safe right of way for vehicles to pull over and utilities to access their assets. The current practice for much of the island is to mow the right-of-way with a boom mower including small trees and limbs than intrude into the area. The area usually

covers five feet from the road edge. This method is effective in keeping drivers' line of site clear from the smaller emergent species of tan-tan (Leucaena leucocephala) and white manjack (Cordia alba) that tend to dominate these areas and grow very quickly.

4. TREE REGULATIONS

There is little coordination between the stakeholders involved in roadside trees, largely because there is no guiding document to assign responsibility or to define acceptable tree management practices. The fourth goal is the creation of such a document. This legally binding document can describe best management practices, assign responsibilities to specific agencies and give permission for particular types of actions, such as tree removal. The Virgin Islands does not currently have appropriate legislation on public or private trees (USVI, Preservation of Public Peace, Security of Pblic Trees; USVI, USVI Code Title 12 Conservation Chapter 2 Protection of Indigenous, Endangered and Threatened Fish, Wildlife and Plants, 1991). As a

result, tree removal, the interference of public trees with public utilities, roadside tree planting and a myriad of other issues are solved on a case by case basis. This inevitably leads to conflict and a great loss of valuable time. Virgin Islands Public Works, the Water and Power Authority (WAPA), Innovative Cable and Telephone, the University of the Virgin Islands and other appropriate agencies should all have the opportunity to make contributions to the document to ensure the proper input and review from the entities involved. Creating this document and passing the legislation is a critical step in the proper management of roadside trees in the US Virgin Islands.

The International Society of Arboriculture (ISA) provides excellent resources to agencies and other groups interested in creating a tree ordinance that is customized and appropriate for unique communities to ensure that the ordinance is workable and has broad support. In addition to ISA, many other sources exist to guide the development of tree ordinances and planting and management plans (NCDOT; Richards, 1983; USDA-FS, A Guide: Developing a Street and Park Tree Management Plan; USDA-FS, Urban Inventory Pilot Supplement; Forest Inventory Analysis, 2006; Dover, Kohl, & Associates, 2011; Arlington County, 2004)

A contract has been awarded by the Department of Agriculture to write a Virgin Islands' tree law.

A. ONLINE RESOURCES

July 2010 Tree Hazard Report

August 2010 Tree Hazard Report

November 2010 Hazard Report

February 2011 Tree Hazard Report

B. DATA TABLES

TABLE B 1:ST. CROIX, U.S. VIRGIN ISLANDS DIAMETER CLASS DISTRIBUTION FOR 10 MOST COMMON ROAD SIDE TREE SPECIES

FS_In	Genip	West Indian M	Tibit	Tamarind	Flamboyant	Coconut	Mango	Turpentine	Dog Almond	Honduras mahogany
4-6	5.7%	1.3%	4.4%	2.8%	1.3%	3.4%	0.8%	2.2%	5.7%	1.5%
6-8	21.6%	2.3%	14.4%	9.3%	1.6%	14.9%	5.8%	6.6%	14.2%	1.0%
8-10	23.5%	3.7%	17.2%	9.6%	7.8%	40.5%	10.3%	12.2%	14.7%	1.9%
10-12	14.7%	3.3%	12.9%	8.5%	8.8%	24.4%	11.1%	11.4%	16.6%	1.9%
12-14	5.7%	4.8%	10.0%	5.3%	9.4%	9.9%	7.8%	12.2%	12.3%	2.9%
14-16	6.8%	5.6%	11.3%	8.1%	12.5%	4.6%	8.6%	16.2%	16.1%	4.9%
16-18	3.5%	3.5%	5.0%	4.9%	14.0%	1.1%	9.1%	9.2%	3.8%	2.4%
18-20	3.9%	5.6%	6.4%	6.7%	9.1%	0.0%	7.0%	10.5%	8.5%	6.3%
20-22	2.3%	5.5%	2.7%	2.2%	9.1%	0.0%	6.2%	3.9%	0.9%	4.4%
22-24	2.3%	8.4%	4.2%	4.9%	4.7%	0.0%	11.1%	6.1%	3.3%	9.7%
24-26	1.5%	6.5%	2.2%	2.4%	6.5%	0.0%	4.5%	2.6%	0.0%	4.9%
26-28	1.2%	8.1%	2.7%	4.7%	4.2%	0.0%	3.3%	2.2%	0.5%	9.7%
28-30	1.0%	8.6%	1.9%	5.1%	4.4%	0.0%	4.1%	2.2%	0.0%	11.7%
>30	4.4%	31.3%	3.4%	19.7%	3.4%	0.0%	9.5%	2.6%	2.4%	35.4%
	98.1%	98.5%	98.7%	94.3%	96.6%	98.9%	99.2%	100.0%	99.1%	98.5%

TABLE B 2:ST. CROIX, U.S. VIRGIN ISLANDS DIAMETER CLASS DISTRIBUTION FOR 10 MOST COMMON ROAD SIDE TREE SPECIES

Class (in)	Honduras mahogany	dog almond	turpentine	mango	coconut	flamboyant	tamarind	tibit	West Indian Mahogany	genip
4-12	6%	52%	32%	28%	84%	28%	32%	50%	11%	67%
12-18	10%	33%	38%	26%	16%	36%	19%	27%	14%	16%
18-24	21%	13%	21%	24%	0%	21%	15%	13%	20%	9%
24-36	46%	1%	9%	15%	0%	14%	20%	9%	39%	6%
>36	16%	2%	0%	6%	0%	1%	14%	1%	16%	3%

TABLE B 3:RELATIVE FREQUENCY, RELATIVE DENSITY, RELATIVE DOMINANCE AND IMPORTANCE VALUE FOR MAJOR ROADSIDE TREE INVENTORY AND HAZARD ASSESSMENT ON ST. CROIX, U.S. VIRGIN ISLANDS FOR SPECIES GREATER THAN 4" DBH

Species	Common	Relative Frequency	Relative Density	Relative Dominance	IV
Acacia macracantha	stink casha	0.23	0.05	0.23	0.17
Acacia tortuosa		0.03	0.00	0.03	0.02
Adansonia digitata	baobob	0.09	0.39	0.09	0.19
Adonidia merrillii	christmas Palm	0.79	0.06	0.79	0.55
Albizia lebbeck	tibit	10.69	6.94	10.69	9.44
Anacardium occidentale	cashew	0.01	0.01	0.01	0.01
Andira inermis	dog almond	2.15	1.14	2.15	1.82
Annona muricata	soursop	0.02	0.02	0.02	0.02

Species	Common	Relative Frequency	Relative Density	Relative Dominance	IV
Annona reticulata	custard apple	0.01	0.00	0.01	0.01
Annona squamosa	sugar apple	0.02	0.00	0.02	0.01
Araucaria heterophylla	norfolk island pine	0.12	0.05	0.12	0.10
Arecastrum romanzoffianum	queen palm	0.01	0.02	0.01	0.01
Artocarpus altilis	breadfruit tree	0.02	0.00	0.02	0.02
Azadirachta indica	neem	1.49	0.29	1.49	1.09
Bauhinia variegata	poor mans orchid	0.02	0.01	0.02	0.02
Blighia sapida	akee	0.01	0.00	0.01	0.01
Bourreria succulenta	pigeon berry	0.28	0.07	0.28	0.21
Bucida buceras	black olive	0.48	0.47	0.48	0.48
Bursera simaruba	turpentine	2.36	1.70	2.36	2.14
Caesalpinia coriaria	dividivi	0.03	0.02	0.03	0.03
Calophyllum calaba	maria	0.02	0.00	0.02	0.01
Canella winterana		0.01	0.00	0.01	0.01
Cassia fistula	golden shower	0.07	0.04	0.07	0.06
Casuarina equisetifolia	australian pine	1.09	1.07	1.09	1.08
Catalpa longissima	haita catalpa	0.01	0.00	0.01	0.01
Cecropia Loefl.		0.02	0.00	0.02	0.01
Cedrela odorata	cigar box tree	0.24	0.39	0.24	0.29
Ceiba pentandra	kapok	0.38	1.15	0.38	0.64
Citharexylum fruticosum	fiddle wood	0.43	0.21	0.43	0.36
Citrus ×sinensis	sweet orange	0.01	0.00	0.01	0.01
Citrus L.	citrus	0.02	0.01	0.02	0.02
Clusia rosea	autograph tree	0.01	0.00	0.01	0.01
Coccoloba diversifolia		0.01	0.00	0.01	0.01
Coccoloba uvifera	seagrape	0.33	0.12	0.33	0.26
Coccothrinax barbadensis	tyre palm	0.01	0.00	0.01	0.01
Cocos nucifera	coconut palm	2.67	0.67	2.67	2.00
Colubrina arborescens	maubi	0.01	0.00	0.01	0.01
Conocarpus erectus	button mangrove	0.01	0.00	0.01	0.01
Cordia laevigata	manjack	0.08	0.04	0.08	0.07
Cordia nitida		0.08	0.04	0.08	0.07
Cordia rickseckeri	orange manjack	0.14	0.01	0.14	0.10
Cordia sebestena	large leaf geiger	0.16	0.06	0.16	0.13
Crescentia cujete	calabash	0.03	0.02	0.03	0.03
Delonix regia	flamboyant	3.92	3.23	3.92	3.69

Species	Common	Relative Frequency	Relative Density	Relative Dominance	IV
Erythrina poeppigiana		0.02	0.00	0.02	0.02
Erythrina variegata		0.03	0.01	0.03	0.02
Eugenia monticola		0.01	0.00	0.01	0.01
Ficus benjamina	fig	0.15	0.10	0.15	0.14
Ficus citrifolia	wild banyantre	0.05	0.01	0.05	0.04
Ficus elastica	indian rubber fif	0.03	0.01	0.03	0.03
Gliricidia sepium	madre de cacao	0.21	0.10	0.21	0.17
Guaiacum officinale	Lignum-vitae	0.06	0.01	0.06	0.04
Guapira fragrans	black mampoo	1.31	0.40	1.31	1.01
Haematoxylum campechianum	logwood	0.27	0.12	0.27	0.22
Hibiscus tiliaceus	sea hibiscus	0.01	0.00	0.01	0.01
Hippomane mancinella	manchineel	0.61	0.14	0.61	0.45
Hura crepitans	sandbox tree	0.20	0.39	0.20	0.26
Hymenaea courbaril	stinking toe	0.30	0.35	0.30	0.32
Kigelia pinnata	sausage tree	0.01	0.03	0.01	0.02
Krugiodendron ferreum	ironwood	0.01	0.00	0.01	0.01
Leucaena leucocephala	tan-tan	0.15	0.02	0.15	0.11
Livistona chinensis	chinensis palm	0.01	0.00	0.01	0.01
Mammea americana	mammee apple	0.01	0.00	0.01	0.01
Mangifera indica	mango	2.48	2.72	2.48	2.56
Manilkara zapota	mesple	0.11	0.03	0.11	0.09
Melia azedarach	china berry	0.07	0.03	0.07	0.06
Melicoccus bijugatus	genip	29.50	16.95	29.50	25.32
Morinda citrifolia	noni	0.12	0.05	0.12	0.10
Moringa oleifera	moringa	0.02	0.01	0.02	0.02
Myrcianthes fragrans	twinberry	0.03	0.01	0.03	0.02
Myrciaria floribunda	guavaberry	0.03	0.00	0.03	0.02
Pandanus utilis	screw pine	0.03	0.00	0.03	0.02
Peltophorum inerme	copper pod	0.22	0.21	0.22	0.21
Persea americana	avocado	0.16	0.05	0.16	0.13
Phoenix sylvestris		0.01	0.01	0.01	0.01
Pilosocereus royenii	pipe cactus	0.01	0.02	0.01	0.01
Pisonia subcordata	water mampoo	0.06	0.05	0.06	0.06
Pithecellobium dulce	sweet bread	0.12	0.04	0.12	0.09
Pithecellobium unguis-cati	bread and cheese	0.27	0.24	0.27	0.26

Species	Common	Relative Frequency	Relative Density	Relative Dominance	IV
Plumeria alba	white frangipani	0.01	0.00	0.01	0.01
Plumeria rubra		0.01	0.00	0.01	0.01
Psidium guajava	guava	0.01	0.00	0.01	0.01
Randia aculeata		0.01	0.00	0.01	0.01
Roystonea borinquena	royal palm	0.69	0.44	0.69	0.61
Sabal causiarum	Puerto Rico hat palm	0.11	0.06	0.11	0.09
Samanea saman	rain tree	1.75	3.96	1.75	2.49
Sapindus saponaria		0.04	0.00	0.04	0.03
Schefflera actinophylla	umbrella tree	0.01	0.00	0.01	0.01
Senna siamea	siamese senna	0.16	0.07	0.16	0.13
Sideroxylon foetidissimum	bully-mastic	0.07	0.04	0.07	0.06
Spathodea campanulata	African tulip	0.11	0.08	0.11	0.10
Spondias mombin	hogplum	1.11	1.38	1.11	1.20
Spondias purpurea		0.01	0.00	0.01	0.01
Swietenia Jacq.	Mahogany hybrid	1.93	3.44	1.93	2.43
Swietenia macrophylla	Honduras mahogany	2.09	4.51	2.09	2.90
Swietenia mahagoni	West Indian mahogany	16.63	35.62	16.63	22.96
Syagrus romanzoffiana	queen palm	0.01	0.02	0.01	0.01
Tabebuia aurea	trumpet tree	0.19	0.07	0.19	0.15
Tabebuia heterophylla	pink poui	1.25	0.46	1.25	0.98
Tamarindus indica	tamarind	4.78	7.35	4.78	5.64
Tecoma stans	ginger thomas	0.07	0.12	0.07	0.09
Terminalia catappa	tropical almond	0.35	0.21	0.35	0.30
Thespesia populnea	seaside mahoe	0.15	0.06	0.15	0.12
Trema micrantha	white manjack	0.68	0.23	0.68	0.53
Triphasia trifolia	sweet lime	0.01	0.00	0.01	0.01
UNKNOWN	UNKOWN	1.40	1.09	1.40	1.30
Zanthoxylum monophyllum	yellow prickle	0.21	0.08	0.21	0.17
Ziziphus mauritiana	Indian ju-jube	0.75	0.25	0.75	0.58

Importance value (IV) for each species was calculated by taking the average of relative dominance (each species basal area divided by total basal area), relative density (each species trees per hectare divided by total trees per hectare) and relative frequency (each species count divided by the total tree count) multiplied by 100.

TABLE B 4:RELATIVE FREQUENCY, RELATIVE DENSITY, RELATIVE DOMINANCE AND IMPORTANCE VALUE FOR MAJOR ROADSIDE TREE INVENTORY AND HAZARD ASSESSMENT ON ST. CROIX, U.S. VIRGIN ISLANDS FOR SPECIES GREATER THAN 4" DBH COMPARED TO IITF 2004 FOREST INVENTORY FOR THE USVI

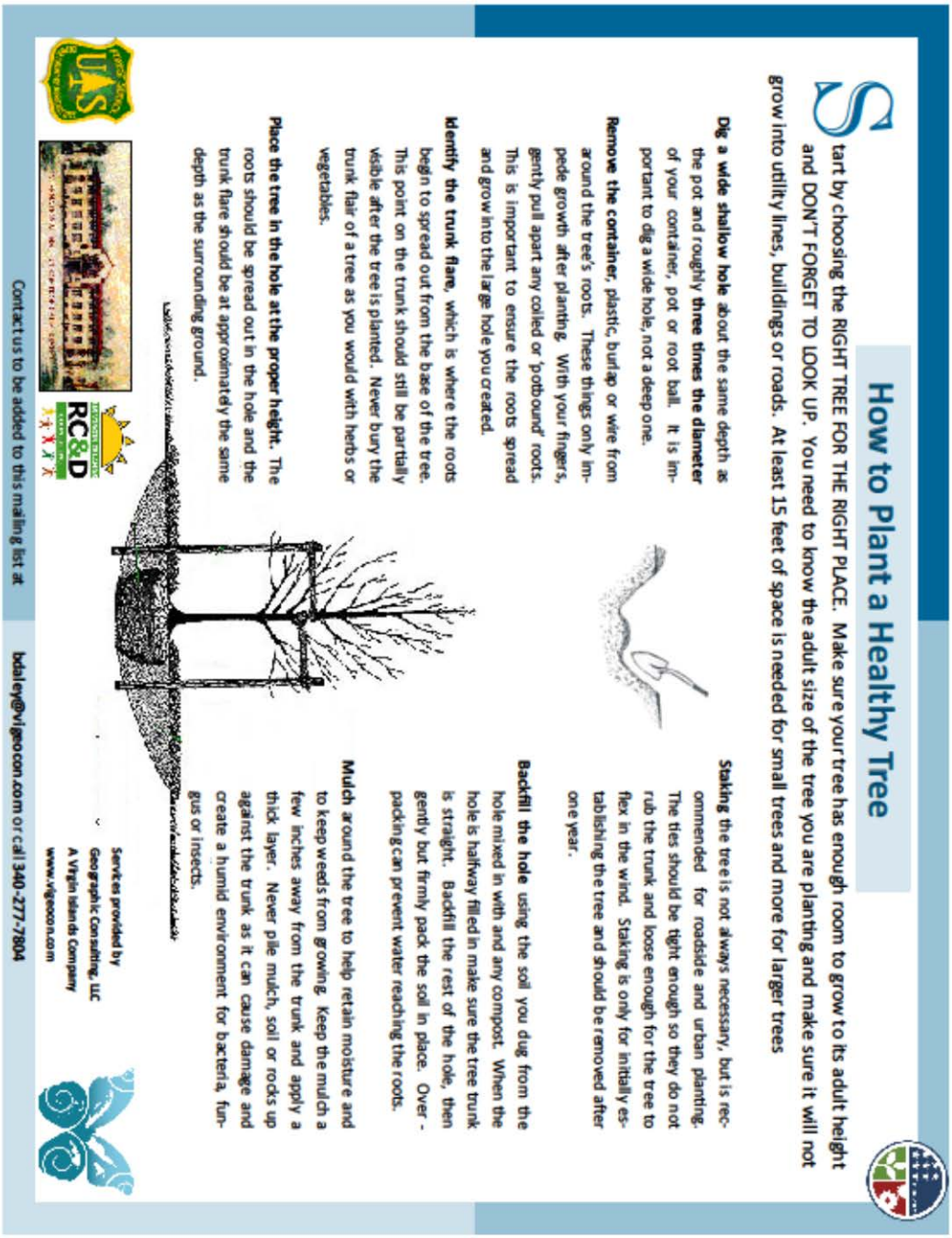
Species	RelFreq	RelDensity	RelDom	IV	IITF REL FREQ
Swietenia mahagoni	17%	17%	36%	23%	0%
Melicoccus bijugatus	30%	30%	17%	25%	7%
Tamarindus indica	5%	5%	7%	6%	1%
Albizia lebbeck	11%	11%	7%	9%	1%
Swietenia macrophylla	2%	2%	5%	3%	0%
Samanea saman	2%	2%	4%	2%	1%
Swietenia Jacq.	2%	2%	3%	2%	0%
Delonix regia	4%	4%	3%	4%	1%
Mangifera indica	2%	2%	3%	3%	0%
Bursera simaruba	2%	2%	2%	2%	10%

C. HAZARD TREES MAPPING AND DATABASES

Full size maps (24”x36”) are not available in this document due to size limitations. Data is available upon request in multiple formats.

1. ESRI Geodatabase
2. Microsoft Access
3. Google KML and KMZ
4. Spreadsheets

D. TREE PLANTING GUIDE



How to Plant a Healthy Tree

Start by choosing the RIGHT TREE FOR THE RIGHT PLACE. Make sure your tree has enough room to grow to its adult height and DON'T FORGET TO LOOK UP. You need to know the adult size of the tree you are planting and make sure it will not grow into utility lines, buildings or roads. At least 15 feet of space is needed for small trees and more for larger trees

Dig a wide shallow hole about the same depth as the pot and roughly **three times the diameter** of your container, pot or root ball. It is important to dig a wide hole, not a deep one.

Remove the container, plastic, burlap or wire from around the tree's roots. These things only impede growth after planting. With your fingers, gently pull apart any coiled or 'potbound' roots. This is important to ensure the roots spread and grow into the large hole you created.

Identify the trunk flare, which is where the roots begin to spread out from the base of the tree. This point on the trunk should still be partially visible after the tree is planted. Never bury the trunk flair of a tree as you would with herbs or vegetables.

Place the tree in the hole at the proper height. The roots should be spread out in the hole and the trunk flare should be at approximately the same depth as the surrounding ground.

Staking the tree is not always necessary, but is recommended for roadside and urban planting. The ties should be tight enough so they do not rub the trunk and loose enough for the tree to flex in the wind. Staking is only for initially establishing the tree and should be removed after one year.

Backfill the hole using the soil you dug from the hole mixed in with and any compost. When the hole is halfway filled in make sure the tree trunk is straight. Backfill the rest of the hole, then gently but firmly pack the soil in place. Over-packing can prevent water reaching the roots.

Mulch around the tree to help retain moisture and to keep weeds from growing. Keep the mulch a few inches away from the trunk and apply a thick layer. Never pile mulch, soil or rocks up against the trunk as it can cause damage and create a humid environment for bacteria, fungus or insects.

Contact us to be added to this mailing list at bdaley@vigeocon.com or call 340-277-7804

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Small Trees for Roadside Planting
U.S. Virgin Islands

Geographic Consulting

Common Name	Scientific Name	Adult Height	Ornamental Flower	Attracts Wildlife	Salt Tolerance	Draught Toler-ance	Growth Rate	Unique Characteristic
Autograph Tree	*Clusia rosea*	35	YES	YES	High	High	Slow	Thick leathery leaves, spreading crown and attractive 'upside-down' flowers attract bats and birds
Black Mampoo	*Guapira fragrans*	35	NO	YES	High	High	Med.	Dark green leaf canopy and tolerant of roadside conditions
Button Mangrove	*Conocarpus erectus*	35	NO	NO	Very High	Very High	Med.	Hardy to elements and roadsides. Silver leaf variety available, can be made into a hedge.
Divi-Divi	*Caesalpinia coriaria*	25	NO	NO	High	Very High	Med.	Delicate, many branched canopy, often leaning in the wind. Tolerant of very dry and windy sites
Fiddle Wood	*Citharexylum fruticosum*	40	NO	YES	Med.	High	Med.	Fragrant but small flowers, and juicy fruit attracts wildlife. Can get large over time.
Guavaberry	*Myrciaria floribunda*	40	NO	YES	Med.	High	Slow	Fragrant white flowers and famous, edible black/purple fruit, smooth bark. Does not grow in caliche soil
Ironwood	*Krugiodendron ferreum*	30	NO	YES	Med.	High	Slow	A compact tree with shiny dark green foliage and black berries that attract birds. Very slow growing.
Jamaican Caper	*Capparis cynophallophora*	20	YES	YES	Very High	Very High	Slow	Well formed, symmetrical canopy with profuse, showy white to pinkish flowers. One of the showiest of native trees. Excellent for wildlife.

Small Trees for Roadside Planting

U.S. Virgin Islands

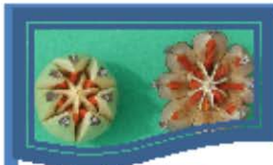
Common Name	Scientific Name	Adult Height (ft)	Ornamental Flower	Attracts Wildlife	Salt Tolerance	Draught Toler-ance	Growth Rate	Unique Characteristic
Lignum-vitae	*Guaiacum officinale*	30	YES	YES	High	Very High	slow	Showy purple flowers throughout the year and small yellow fruit. Extremely valuable wood. Ornamental but slow growing.
Orange Manjack	*Cordia rickseckeri*	35	YES	YES	Med.	High	fast	Showy orange flower clusters and the large leaves have a distinct orange stripe.
Pigeon Berry	*Bourreria succulenta*	30	NO	YES	Med.	Very Good	Med.	Fairly common native tree with fragrant white flowers and bright red fruit clus-ters throughout the year. Beneficial to wildlife
Tyre Palm	*Coccothrinax alta*	25	NO	NO	Med.	Med.	slow	Attractive fan shaped leaves with silver undersides, and slender trunk.
Uverillo	*Coccoloba microstachya*	25	NO	NO	Very High	High	Med.	Tough tree, hardy to elements. Similar to sea grape but smaller in stature.
White Frangipani	*Plumeria alba*	25	YES	NO	Very High	Very High	Med.	Showy and fragrant white flower clusters with yellow centers. Ideal for the driest sites.

Tall Trees for Roadside Planting

U.S. Virgin Islands

Geographic Consulting
Natural Resource Management

Common Name	Scientific Name	Adult Height (ft)	Ornamental Flower	Attracts Wildlife	Salt Tolerance	Draught Toler-ance	Growth Rate	Unique Characteristic
Baobob	Adansonia digitata	60	YES	NO	Low	High	Med.	Massive, stout, smooth trunk. Culturally significant African tree. Large flowers and fruit can be a nui-sance.
Bay Rum	Pimenta racemosa	45	NO	NO	Low	Med.	Slow	Attractive , smooth bark and fragrant leaves used for tea and bay rum. Does not tolerate caliche soil
Black Olive	Bucida buceras	60	NO	NO	High	Low	Slow	Iconic dry forest species with strong wood. Once common, now rare. Prefers guts and moist sites
Bully Mastic	Sideroxylon foetidissimum	80	NO	NO	High	High	Med.	Long lived, increasingly rare native tree with attractive yellow flowers, and valuable hardwood.
Dog Almond	Andira inermis	60	YES	NO	Med.	Med.	Med.	Native tree looks similar to mahogany but with clusters of small, attractive, but short lived purple flowers. Bats attracted to large fruit.
Kapok	Ceiba pentandra	80	NO	NO	Med.	High	Fast	Giant, fast growing tree known for its buttress roots and thorny trunk. Tall and spreading canopy that releases large volumes of fluffy cotton
Mesple	Manilkara zapota	60	NO	NO	High	High	Slow	Hardy tree with edible fruit prefers moist sites. Large fruit make this tree inappropriate for areas above vehicles.
Pink Poui	Tabebuia heterophylla	50	YES	NO	Med.	High	Med.	Drought and stress tolerant tree that produces many showy pink blooms throughout the year



Tall Trees for Roadside Planting

U.S. Virgin Islands

Common Name	Scientific Name	Adult Height (ft)	Ornamental Flower	Attracts Wildlife	Salt Tolerance	Draught Toler-ance	Growth Rate	Unique Characteristic
Maria	Calophyllum calaba	50	Yes	Yes	high	medium	moder-ate	Ornamental non-native tree. Dense, dark green canopy and fragrant white flowers. Bats are attracted to the large fruit.
Royal Palm	Roystonea borinquena	60	NO	NO	Med.	Low	Med.	Tall, majestic native palm. Demands moist sites and tolerates flooding. Flowers and seeds are valuable for wildlife.
Sandbox Tree	Hura crepitans	80	NO	NO	Low	Med.	Fast	Large size, thorns and caustic sap make this tree appropriate only in certain areas. Dry fruit 'explodes' when ripe and artisans make jewelry from the shells.
Turpentine	Bursera simaruba	50	NO	YES	High	Very High	Med.	Fast growing tree tolerant of roadside condi-tions. Attractive, smooth reddish bark. Copi-ous fruit production provides food preferred by rare birds.
Twinberry	Myrcianthes fragrans	50	NO	YES	High	High	Slow	Rare , ornamental native tree with smooth bark and fragrant white flowers. Drought tolerant. Slow growth rate can be challeng-ing to work with.
Water Mampoo	Pisonia subcordata	50	NO	YES	High	High	Fast	Smooth, shiny, swollen trunk, often with ex-posed roots. Soft wood. Attractive and tough tree can get large even in poor soil. Only fe-male trees produce sticky fruit
West Indian Mahogany	Swietenia mahagoni	60	NO	NO	High	High	Med.	Classic Virgin Islands roadside tree, strong wood and tolerant of physical abuse com-mon on roadsides.

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F. Data Collection Descriptions

This list represents the data collected during the rapid assessment conducted on each tree within the ROW. A description of the method of data collection that was given to each member of the field crew is included. This list was input into Trimble Terrasyc and data were later downloaded into a database for data cleaning and analysis.

Tree point data collection is taken with a minimum of 20 logged points with best possible accuracy at base of the stem. If point cannot be taken at base an offset using horizontal distance with the laser rangefinder and a compass is used with the compass declination set at [-13.5 degrees]

1. Data Collector: Drop down list of current data collectors
2. Tree ID: Drop down list by Genus and species of trees
3. Unknown Description: Description or name for unknown or unlisted tree species, description of leaves, bark, twigs, fruit or common name
4. Number stems: One tree with multiple stems below DBH (diameter at breast height) is counted as one tree point with number of stems over 5" in diameter.
5. Height (m): Using the laser range finder, measure height from bottom of tree to the top of tree as defined as the "very top".
6. DBH (in): Diameter at breast height (4.5') perpendicular to the vertical bole or stem. Some variation is occasionally called for. Measured from the top side or high side portion of the stem on a slope. Can be measured slightly below a crotch which is at breast height. Usually measured above the flair of a trunk or at the portion which does not have buttresses all trees >6".
7. Distance to Road (m): Measured with Laser Range Finder with the horizontal setting to edge of the "Road" or white line from . Sidewalks and other features are not included.

8. Crown Measurements: These are taken from the center of the stem to the outside edge of the drip line using the laser range finder horizontal measurement or from the drip line to the tree stem.

9. Drip Percent Permeable: Estimated Area under the drip line that is a permeable surface (Categorical (1- 0-20%, 2- 20-40%, 3-40-60%, 4-60-80%, 5-80-100%)

10. Potential Hazard: Yes/no. Is the tree a potential hazard to a target?

11. Target 1: First potential Target (List)

12. Target 2: Second Potential Target (List)

13. Target 3: Third Potential Target (List)

14. Likely Failure Area: Crown, Trunk, Root: Identify area of most likely failure based on observation of defects.

15. Failure Rating (1-5)☹ Very Poor, Poor, Medium, High, Very High). Categorical rating of failure observation.

16. Hazard Notes: Identify tree hazards (codominant, included, weak stems, etc)

17. Utility Line Conflict (yes/no): Is the tree touching any utility line?

18. Crown Damage (yes/no): Does any part of the crown show some observable damage?

19. Primary Crown Damage: Identify most likely cause of damage or defect

20. Secondary Crown Damage: Identify most likely cause of damage or defect

21. Crown Notes: notes and explanation of 'see other"

22. Level of Crown Damage (0-5): (None, Very Low, Low, Medium, High, Very High)

23. % dead: Estimated % of crown damaged or missing

24. Trunk Damage (yes/no): Does any part of the trunk show some observable damage?

25. Primary Trunk Damage: Identify most likely cause of damage or defect

26. Secondary Trunk Damage: Identify most likely cause of damage or defect

27. Trunk Notes: notes and explanation of 'see other"

28. Level of Trunk Damage (0-5): (None, Very Low, Low, Medium, High, Very High)

29. Tip Die Back (yes/no): Observable tip die back

30. Paved Conflict (yes/no): Signs of up swell or breakage

31. Root Damage (yes/no): Does any part of the root area show some observable damage (exposed, tip up in back, hollow roots, etc)?

32. Primary Root Damage: Identify most likely cause of damage or defect

33. Secondary Root Damage: Identify most likely cause of damage or defect

34. Root Notes: notes and explanation of 'see other"

35. Level of Root Damage (0-5): None, Very Low, Low, Medium, High, Very High)

36. Health Rating (1-5): Health rating based on initial observations in the field, Very Low, Low, Medium, High, Very High

37. Disease Presence (yes/no): Identifies signs (actual occurrence, disease secretions, etc) or symptoms (defoliation, dieback, etc)

38. Disease Notes: Observed disease or description

39. Recommended Management: Management action recommended based on health rating and hazard potential

40. Date: Date of Data point collection

41. Time: Time of data point collection.