

Stinnett, Chair
Mossotti, Vice Chair
Gorton
Akers
Farmer
Scutchfield
Myers
Clarke
Henson
Lane

A G E N D A

Environmental Quality Committee

February 18, 2014

11:00 A.M.

1. January 28, 2014 Committee Summary (1-3)
2. Material Recovery Facility (MRF) Audit
Follow Up - Henson (4-28)
3. Tree Canopy Survey - Clarke (29-66)
4. Monthly Financials (67-72)
5. Items Referred (73)

"Environmental Quality Committee, to which shall be referred matters relating to the Department of Environmental Quality and its divisions, and any related partner agencies."

-Council Rules & Procedures, Section 2.102(1)

2014 Meeting Schedule

Jan 28	May 13	Sept 16
Feb 18	June 24	Oct 14
Mar 11	July 8	Nov 18
Apr 15	Aug 19	



Environmental Quality Committee
January 28th, 2014
Summary and Motions

Council Member Stinnett called the meeting to order at 11:00am. Council Members Gorton, Akers, Farmer, Scutchfield, Myers, Clarke and Henson were present. Council Members Mossotti and Lane were absent. Council Member Kay was present as a non-voting attendee.

1. November 12, 2013 Committee Summary

Motion by Scutchfield to approve the November 12, 2013 committee summary. Seconded by Gorton. Motion passed without dissent.

2. Keep Lexington Beautiful Annual Report

Jim Pendergest provided the Keep Lexington Beautiful annual report to the committee.

Scutchfield asked what the enforcement results were for the new littering law. Pendergest did not know the number. Scutchfield felt it was useful and asked if we could get it. She requested that we track this information going forward.

Farmer commented on the success of the Richmond Rd. clean up and asked what kind of outreach was planned going forward. Pendergest said that had partnered with Lowe's and planned some smaller projects and had assigned a group to work with neighborhoods to give grants for clean up type projects.

Henson commented on the change in the litter law. It gives the government the option of citing as criminal or civil (ex. dump sites - criminal), everyday littering can be civil.

Myers asked if an illegally placed yard sign fit the definition. Jarvis stated that this was a code issue. Myers wants to abate illegally placed yard signs, would this fit under the new state law. Jarvis said we could look at this locally as part of KLB. Myers asked for research on the issue and a report to the committee.

Stinnett asked what the annual budget is for KLB. Pendergest said they are funded by donations and do not currently receive support from the City. Their current annual budget is \$16K.

3. Waste Management Audit Follow Up

Bruce Sahli provided an update on the waste management audit to the committee.

Henson asked Hamilton/Martin how Council could be assured when they get these audits, some of which are alarming, going forward that there will be follow up and things are going to continue to get better. Hamilton stated that the Mayor met with IA quarterly to and his concern is also follow up. He feels that IA needs to go back in to ensure that changes are being made. Hamilton added that they (Administration) need to take these audits and follow up as managers and not just rely on IA to point out when issues have not been addresses or corrected.

Stinnett stated that there many of the items addressed in the audit are the result of communication issues (SOPs are not communicated), how have we corrected communication in the division and how is it working now. Martin stated that there was a leadership change in December and the approach they are taking the approach of trying to eliminate the filters as that seems to be a big part of the communication problem. When they visit they stop in and talk with the front line employees first rather than just go straight to the second floor. He has also reassigned an employee to be located in the Commissioner's office to focus on the standard operating procedures because he didn't create them and would like the opportunity to look at them a little more closely particularly how they relate to what is done in water quality. They are also going to focus on regular ongoing communication rather than issuing a memo.

Clarke asked about uniforms for waste management employees being classified as a benefit and pointed out that the audit findings seem to contradict this stating that uniforms are excluded from wages if they are required for employment (page 14). Sahli stated that it depends on the type of uniform and whether it can be worn outside of the workplace (boots, polo shirts, etc.). This was mentioned to ensure that if there was an IRS requirement that we are following it. Sahli added that he had added a lot more follow ups to the internal audit plan that was approved by the board.

4. Monthly Financials

O'Mara provided an overview of the monthly financials for the sanitary sewer operating fund (4002) and pointed out that the second revenue line (\$6.2M) actually belongs in the next fund (construction fund) and will be corrected. The remaining information is just a snap shot of where we are in the year. Page 47, water quality fund, page 48 newly created construction fund for water quality and landfill is on page 49, all are for the first 6 months thru December 31st.

Stinnett asked if there could be a brief comment on the revenues. It appears we are ahead of schedule for the first 6 months on all revenues, are revenues coming in as we projected given the new LexServ bill and the billing system on these three funds. O'Mara said they are in the process of an extensive research and verification of our collection rate. They are vetting the information received by Cincinnati water to be sure it is interpreted correctly and he would like to add this to the agenda for next month to be sure he has the information evaluated properly before sharing. Stinnett added that it looks like revenues are higher. O'Mara stated that they are trying to determine why.

5. Items Referred

Stinnett walked the committee through the referred items list.

Stinnett asked for a report back on the UK game day solid waste collection issue to see if it needs to remain in committee. Stinnett also asked for a report back on the bulky item collection issue. Farmer asked that the committee look at these two issues and see what the revenue sources are before dropping them.

Motion by Myers to remove the division of water quality construction process from the committee referral list. Seconded by Scutchfield. Motion passed without dissent.

Motion by Farmer to remove the annual report on public education effectiveness from the committee referral list. Seconded by Scutchfield. Motion passed without dissent.

Motion by Myers to remove the waste management expenditure audit from the committee referral list. Seconded by Scutchfield. Motion passed without dissent.

Motion by Farmer to adjourn. Seconded by Clarke. Motion passed without dissent.



Lexington-Fayette Urban County Government
OFFICE OF INTERNAL AUDIT

INTERNAL AUDIT REPORT

DATE: January 24, 2014

TO: Jim Gray, Mayor

CC: Sally Hamilton, Chief Administrative Officer
Charles Martin, Acting Commissioner, Environmental Quality & Public Works
William O'Mara, Commissioner of Finance & Administration
Janet Graham, Commissioner of Law
Phyllis Cooper, Director of Accounting
Tracey Thurman, Acting Director of Waste Management
Susan Straub, Communications Director
Urban County Council Members
Internal Audit Board Members

FROM: Bruce Sahli, CIA, CFE, Director of Internal Audit
Alicia Boyd, CPA, Internal Auditor

RE: MRF Collections Process Audit

Background

The Material Recovery Facility (MRF) is a recycling facility that since the summer of 2010 has operated a "single stream" recycling program. Single stream refers to a system in which all paper fibers, plastics, metals, and other containers are mixed in a collection truck, instead of being sorted by the depositor into separate commodities (plastics, glass, newspapers, etc.) and then handled separately throughout the collection process. In single stream, both the collection and processing systems are designed to handle this fully commingled mixture of recyclables, with materials being separated for reuse at the MRF.

In addition to the weekly collection of recycled items from LFUCG taxpayers who pay for the collection service through an additional ad valorem tax (about 70% of materials

collected), the MRF also accepts recycled items from several surrounding local governments, the University of Kentucky, and independent waste haulers (about 30% of materials collected). The MRF collects a processing fee of \$35 per ton from each of these affiliates. Each affiliate, in turn, receives a portion of revenue generated from the sale of recycled goods.

The MRF recycles steel cans, aluminum cans, certain plastic containers, newspaper, office paper, glass, corrugated boxboard, and fiber board. With the exception of aluminum cans, MRF recycled products are sold to various mills through Bluegrass Regional Recycling Center (BRRC) brokerage services, for which BRRC receives a \$7 per ton broker fee. The MRF sells aluminum cans directly to various mills without the services of BRRC.

Revenue is generated via proceeds from the sale of recycled commodities. As reported in PeopleSoft, for FY 2011, FY 2012, and FY 2013 the MRF generated revenue of \$2.36 Million, \$2.36 Million, and \$1.9 Million, respectively, and incurred operating costs of \$2.89 Million, \$2.6 Million, and \$2.52 Million, respectively.

Scope and Objectives

The general control objectives for the audit were to provide reasonable assurance that:

- Resalable inventory produced by the MRF is properly safeguarded and accounted for
- Payments to LFUCG for commodities sold during FY 2011, 2012, and 2013 were accurately calculated and properly supported
- Collections and receivables for FY 2011, 2012, and 2013 were properly recorded and reported
- Collections for FY 2011, 2012, and 2013 were accurately deposited on a timely basis
- Overtime incurred by MRF employees from January 1, 2010 through June 30, 2013, appears necessary and properly managed
- Vendor providing temporary labor is in compliance with the current contract
- Security issues, OSHA requirements, and LFUCG Division of Risk Management issues are being corrected in a timely fashion

Audit results are based on observations, inquiries, transaction examinations, and the examination of other audit evidence and provide reasonable, but not absolute, assurance

controls are in place and are effective. In addition, effective controls in place during an audit may subsequently become ineffective as a result of technology changes or reduced standards of performance on the part of management.

The scope of our audit included:

- Revenues collected/recognized at the MRF during FY 2011, 2012 and 2013 (including Receivables on June 30, 2013)
- Resalable inventory on hand at the MRF, including inventory on June 30, 2013
- Limited review of overtime incurred for MRF employees from calendar year 2010 through June 30, 2013
- Limited review of temporary labor costs, specifically for supervision during FY 2013, and a limited review of the most current contract language (Resolution 607-2010) related to temporary labor
- Security and OSHA issues

Statement of Auditing Standards

We conducted our audit in accordance with the International Standards for the Professional Practice of Internal Auditing. Those standards require that we plan and perform the audit to afford a reasonable basis for our judgments and conclusions regarding the organization, program, activity, or function under audit. An audit also includes assessments of applicable internal controls and compliance with requirements of laws and regulations when necessary to satisfy the audit objectives. We believe that our audit provides a reasonable basis for our conclusions.

Audit Opinion

In our opinion, the controls and procedures did not provide reasonable assurance that the general control objectives were being met. Opportunities to enhance controls are included in the Summary of Audit Findings.

Priority Rating Process

To assist management in its evaluation, the findings have been assigned a qualitative assessment of the need for corrective action. Each item is assessed a high, moderate, or low priority as follows:

High - Represents a finding requiring immediate action by management to mitigate risks associated with the process being audited.

Moderate – Represents a finding requiring timely action by management to mitigate risks associated with the process being audited.

Low - Represents a finding for consideration by management for correction or implementation associated with the process being audited.

SUMMARY OF AUDIT FINDINGS

Finding #1: The MRF Should be Considered for Assignment to a Separate Enterprise Fund

Priority Rating: High

Condition:

The MRF is currently a section of the Division of Waste Management, and is therefore included in the Urban Services Fund, a governmental fund of LFUCG. However, in reality the MRF is a manufacturing operation that collects revenue generated from the sale of its recycled commodities to buyers on the open market, and is therefore better suited to be accounted for via an Enterprise Fund due to its business-type activity. The Governmental Accounting Standards Board (GASB) defines an Enterprise Fund as a proprietary fund type used to report an activity for which a fee is charged to external users for goods or services.

Effect:

Under the current reporting method it is difficult to determine if the MRF revenues are sufficient to cover its cost of operations since governmental funds do not report certain types of expenses (i.e. depreciation expense and bad debt expense) that are reported by enterprise funds, or to determine if the current fee structure at the MRF subsidizes other counties for using its recycling facility.

Recommendation:

Senior management should consider removing the MRF from the Urban Services Fund and having its financial activities reported through its own Enterprise Fund. It is possible to develop an operating and capital budget based on MRF's historical financial information for revenue and expenses from the previous three fiscal years (the MRF was upgraded in June 2010).

Director of Waste Management Response:

While accurately tracking annual expenditures at the MRF is very important in calculating our operating cost per ton and in gauging DWM's efforts toward more efficient operations, it is equally important to recognize that revenue from the sale of commodities is subject to wide fluctuations and, as such, is not a stable funding source for an ongoing operation. While we have enjoyed per ton prices in excess of \$100 (average across all commodities) for several years, the commodities price have dipped significantly to the \$60-\$70 range this year. Other financial benefits include reduced landfill tipping fees and increased opportunities for automation and streamlined collection systems over the long term. The latter is quite significant and is a real benefit but very hard to measure on a year to year cost benefit analysis.

The MRF enterprise is a component of an overall waste management strategy to handle waste in an environmentally responsible manner, while pursuing efficiency in both the collection and resource management parts of our operation. As with other DWM management systems such as E-waste, composting, household hazardous waste and particularly landfill disposal, they are not self-funding operations. While the MRF operations comes the closest to meeting this standard the commodity revenue alone will not allow for a stable funding system.

Acting Commissioner of EQ&PW Response:

A decision regarding creation of a recycling enterprise fund should rest with the administration and council. Accurate accounting (revenues and expenses) is essential to assure that the fee structure is equitable between LFUCG and the affiliated MRF users.

Finding #2: The MRF Operation Needs an Exclusive Management Team to Manage Its Operations

Priority Rating: High

Condition:

The Director of the Division of Waste Management currently oversees more than 200 employees who collect recyclables, yard waste, and trash throughout the Urban County Government, as well as being responsible for the MRF operation. The MRF is a

manufacturing operation with challenges unique to that type of environment, and in our opinion requires its own unique management team with extensive industry experience.

Effect:

As noted in other findings in this report there are many security, Occupational Safety and Health Administration (OSHA), administrative, operational, accounting and internal control issues at the MRF, many of which could have been prevented or at least detected sooner. Although a Program Manager Senior (the overall plant manager) was on hand at the MRF, given the organizational structure it appears that major decisions were deferred to upper management (i.e., the Division Director) who, given his many other responsibilities, did not always ensure the concerns were addressed in a timely fashion.

Recommendation:

A senior management individual (perhaps at the Deputy Director level) should be hired as soon as possible and assigned the task of correcting the problems and implementing the recommendations noted in this report and in other reports issued by the Division of Risk Management and OSHA. Going forward, this senior manager should be provided the authority to manage the MRF. The Director of Waste Management should be informed of the decisions made without being required to provide day-to-day input into those management decisions.

Director of Waste Management Response:

I agree with the recommendation for a Deputy Director for the Division, although that would require reclassification of the Director's position while it is vacant to allow the Deputy Director to have oversight over the Program Manager Senior positions in DWM.

I agree that the MRF, as referenced in the recommendation, is an intense manufacturing operation not typically found under direct government management. I do believe there are three recent changes that have either occurred or are underway that will improve the management and oversight over the MRF.

1. Contracting with an outside entity to manage floor operations.
2. A recently hired safety manager who is actively engaged with MRF operations.
3. Filling the Program Manager Senior position with a candidate who will be actively engaged with the management of the facility.

Acting Commissioner of EQ&PW Response:

The recruitment of a plant manager with extensive experience in an industrial manufacturing facility would, in my opinion, be a better outcome than hiring a deputy

director or filling the Program Manager Sr. position utilizing the current position description.

The plant manager would:

- Report and maintain a full-time presence at the MRF. Past practice has sometimes had the Program Manager Sr. position reporting to the Byrd Thurman offices, with visits to the MRF as necessary. I am of the opinion that the lack of full-time presence by a plant manager driven by operation metrics is a contributing factor to inefficiencies at the facility.
- The plant manager should be given specific operational metrics in which to manage the day to day operations and otherwise have autonomy in the administration of his/her staff or budget. Considerable effort is necessary to establish those performance metrics initially and refine them as necessary in the future.

The Commissioner's office agrees that contracting with a new entity to manage MRF floor operations should result in improved efficiencies at the MRF.

The Commissioner's office is working to establish an enhanced safety program throughout the Division of Waste Management. The Risk Management report dated July 31, 2012 is currently under review with a goal of implementing near-term corrective action immediately.

Finding #3: The MRF Needs an Accountant to Oversee its Financial Activities
Priority Rating: High

Condition:

The following accounting issues were noted during the course of the audit: 1) accounts receivable were not tracked throughout the fiscal year and no policy exists for NSF checks or late payment fees; 2) inventory was not reported to the Division of Accounting at fiscal year-end; 3) inventory was not reconciled to available production records; 4) affiliate payments (for other entities who bring their commodities to the MRF and share part of the sale proceeds) were deducted from revenue account 42512 rather than through an established liability account 24999; 5) as a result of item 4, affiliate payments were not always deducted from the proper fiscal year (i.e. June 2012 affiliate payments were deducted from 2013 recognized revenue) resulting in improper revenue recognition; 6) Nine out of 159 (5.7%) revenue transactions from fiscal years 2011, 2012 and 2013 were not properly accrued since some payments for shipments occurring in June were recorded as recognized revenue in the next fiscal year.

We brought items 2, 4, and 5 to the attention of management during fieldwork and steps have been taken to correct them, but many of these issues could have been avoided if an employee with a strong accounting background worked on-site at the MRF.

Effect:

At any given time, the LFUCG may not know the amount of payments due from commodity buyers, nor if the buyers' payments are past due. Additionally, if revenue is not properly recognized, a departure from generally accepted accounting principles exists. Although inventory is periodically counted to determine if a sale is warranted to create storage space for more recycled commodities, if inventory levels are linked to a production report it can be maintained on a perpetual basis. Failure to report year-end inventory value to Accounting may be a violation of generally accepted accounting principles.

Recommendation:

An accountant should be hired for the MRF as soon as possible and given the task of implementing all accounting related recommendations included in this report. The accountant should make every effort to utilize any modules in PeopleSoft for Accounts Receivable tracking and immediately create term agreements with the buyers to establish time periods for payments and late fee charges, NSF charges, ownership of inventory, etc. We also recommend the MRF accountant report administratively to the MRF senior manager or the Director of Waste Management, but report operationally to the Director of Accounting.

Director of Waste Management Response:

I agree with the recommendation and believe that funds for an accountant should be included in the FY-2015 budget for DWM. An outside accountant has been hired to develop protocols and process to properly track the shipments, receivables and disbursements to outside haulers. The recommendations will be incorporated into the plan the accountant develops and PeopleSoft will be used where the applications are practical.

Acting Commissioner of EQ&PW Response:

The Commissioner's office agrees with the Internal Audit recommendation assuming that the recommendation is that while the accountant reports daily to offices located at the MRF, the accountant only receives work assignments and directives from the Department of Finance. For clarity, the current accountant is a contract employee, not a merit/non-merit position.

Finding #4: MRF Security Issues Noted
Priority Rating: High

Condition:

During the audit several MRF employees expressed concerns over lax security measures. We were informed that several interior and exterior doors have never been rekeyed and there is no way to determine how many keys exist or who may possess them, including employees who no longer work at the MRF. We also noted that one door in the back of the plant is broken and cannot be locked.

The lower gate is secured with a pad lock having a combination code that is used by drivers needing access to the premises after hours to pick up drop loads ready for transportation. We also noted that cameras have been installed both outside the plant where the trucks are weighed as well as inside the plant floor. Additionally, a chain length fence surrounds the entire perimeter. The only vehicle access to the premises is through one of two gates: truck gate (mentioned above) and the all other vehicles gate (upper gate).

Effect:

The absence of accountability for plant keys is a significant concern. If the plant and administrative offices are not properly secured, items can be stolen from the facility. Of even greater concern is the risk that an unauthorized person could enter the plant after hours and fall into the recycling machinery, resulting in a catastrophic event that could subject the LFUCG to a lawsuit.

Recommendation:

MRF management should work with the Department of General Services to determine which doors need rekeyed and which doors may possibly need conversion to a card scan entry door. The door in the back of the plant should be repaired or replaced immediately. The lower gate used by drivers should be replaced with an electronic gate and each driver that needs access afterhours should be given an individual access code for entry. If possible, the gate should have memory capability to recall which code was used for entry.

Director of Waste Management Response:

Work orders were submitted in October with Fleet and Facilities Management to rekey the door locks and to repair the rear door. DWM management will explore the feasibility of an electronic gate and individual access code system.

Acting Commissioner of EQ&PW Response:

The Commissioner's office agrees with the recommendations of Internal Audit.

Finding #5: Excessive Amounts of Overtime Routinely Incurred by Certain MRF Employees

Priority Rating: High

Condition:

Over the past three calendar years (the scope of the audit) excessive amounts of overtime have been incurred by certain employees of the MRF. The table below includes an analysis:

Calendar Year	# of employees analyzed and total MRF employees	% of OT to gross salary	Average hours OT worked per week	Total OT for MRF	Total OT for employees analyzed
2011	5 of 16	26% to 41%	12-21 hrs	\$104,774	\$90,359
2012	7 of 19	27% to 38%	10-21 hrs	\$140,470	\$127,673
2013 through July 25, 2013	5 of 18	28% to 40%	13-21 hrs	\$74,608	\$65,957

During the audit we received an allegation stating that in 2013 there were two separate incidents where the production of recycled material was intentionally slowed down in order to incur additional overtime, and that senior MRF management was aware of the incidents but did not take corrective action. However, this would only account for a small portion of the overtime incurred in 2013.

It should also be noted that MRF's overtime budget for the past three fiscal years has been \$50,000 each year, and each fiscal year the overtime budget has been significantly overspent. While this is an acceptable practice as long as the Division as a whole does not overspend its payroll budget, overtime in a specific section still warrants management oversight and control. It should also be noted that the Division did not overspend its overall payroll budget during any of the three fiscal years examined.

Effect:

While some overtime may be necessary, the amount of overtime incurred at the MRF should be investigated by upper management as it increases the amount of payroll costs, including fringe benefits paid by the LFUCG. In addition, given its unique operation and the type of manufacturing equipment housed within the MRF, if an employee consistently

works extended hours five days a week and also works on Saturday to perform maintenance, accidents due to employee fatigue are more likely to occur. Management may also want to investigate whether the distribution of overtime at the MRF is equitable based on the skills and overtime work requests of its employees.

Recommendation:

Senior management should investigate the reasons for the overtime and develop solutions to eliminate excessive overtime. This could include introducing a second shift designed specifically to provide equipment maintenance, or perhaps staggering the shift of the current employees so everyone works a normal day without incurring excessive amounts of overtime.

Director of Waste Management Response:

The MRF has run without adequate staffing to provide maintenance and operational support for a number of years resulting in excessive overtime. An RFP has been issued and a respondent is under review to contract with an outside entity manage and staffing for floor operations related to maintenance, equipment operation and sorting activities should dramatically reduce the overtime. This should effectively eliminate the need for most staff overtime.

Acting Commissioner of EQ&PW Response:

The department concurs that excessive overtime should be addressed. The contract operations vendor noted in the division's response will provide the opportunity to drastically reduce overtime at the facility.

That being said, the department is currently focused on having a new management structure in place at the MRF so that the overtime cost reduction is not simply replaced with increased contract operations costs.

Over the next 60 days, the department expects to have resolved remaining questions with the contract operations vendor so that an operations contract can be submitted for council approval and mitigation of the excessive overtime can begin.

Finding #6: CAO Policy #40 Deposit Violations Noted
Priority Rating: High

Condition:

The following CAO Policy #40 violations were noted during the test of deposits: 1) the MRF lacks a segregation of duties over mail processing and deposits because the same employee opens the mail and also prepares the deposit; 2) deposits are not properly secured prior to deliver to the Division of Revenue; and 3) there is no mail log to record when a check is actually received in the mail, making it impossible to determine with certainty that deposits are being made in timely manner.

Effect:

Deposits are subject to misappropriation if a proper segregation of duties is not established and deposits are not secured. Management cannot determine if checks are held for a lengthy period of time before processing and depositing if a mail log does not exist.

Recommendation:

Mail should be opened and checks logged by an employee who is not responsible for making the deposit. A locking device such as a small safe should be obtained to secure payments not sent to the Division of Revenue on the same day they are received. This is particularly important because some of the checks received from commodity buyers are for very substantial amounts.

Director of Waste Management Response:

An outside accountant has been hired to develop protocols and process to properly track the shipments, receivables and disbursements to outside haulers. The recommendations will be incorporated into the plan the accountant develops. A small safe to store deposits is being ordered.

Acting Commissioner of EQ&PW Response:

The department concurs with the division's response and also recommends that the action plan be a component of recommendations for Finding # 3.

Finding #7: Issues Noted by Division of Risk Management Not Addressed
Priority Rating: High

Condition:

As a result of the initial walkthrough of the MRF we noted what appeared to be violations of safety rules and notified the Division of Risk Management. We were informed that

Risk Management had spent a significant amount of time addressing safety issues at the MRF, and as recently as October 2012 had issued a report with several findings.

Upon our request, Division of Risk Management personnel re-inspected the MRF and issued another safety violations report in July 2013. The July 2013 report contained two new findings and noted that eleven of the twelve prior findings from the 2012 report were only partially addressed or had not been addressed at all.

Effect:

When safety violations or observations are brought to the attention of any Division, especially one with unique characteristics and challenges such as the MRF, every effort should be made to correct them in a timely manner. This can greatly reduce the potential for a catastrophic work place event that could subject the LFUCG to a lawsuit.

Recommendation:

The safety violations noted by the Division of Risk Management should be promptly corrected. Due to the fact eleven of the twelve safety violations noted in the 2012 report were only partially addressed and in some instances were not addressed at all, senior management should oversee the correction of these issues.

Director of Waste Management Response:

The Plant Manager and the DWM's new Safety Manager are addressing the items in the Risk Management report. They indicated that all items will be addressed by mid-February and a formal response will be sent.

Acting Commissioner of EQ&PW Response:

The department concurs with the division's response but currently believes that full resolution of all report recommendations by mid-February is not attainable.

Two Division of Waste Management employees who would have had key roles in the implementation of corrective actions resigned in mid-December 2013. With an acting division director and acting program manager assuming MRF daily operations in late December, the department believes that the division can begin implementation of corrective actions immediately and should issue progress reports to the department on a monthly basis.

Finding #8: MRF Contractors Providing Outside Services Should be Monitored for Compliance

Priority Rating: High

Condition:

A significant amount of work at the MRF is performed by outside labor services. According to pages 27 and 28 of the temporary labor services contract, the vendor supplying day labor must have a permanent, full-time, on-site employee to act as supervisor over the temporary labor force. The contract states this person must have supervisory experience and skills necessary to manage up to 40 workers, and must also have certain qualifications. This person should also serve as the primary on-site contact/liason for LFUCG personnel to facilitate day to day operations. Additionally, this person will be billed at \$12.49 per hour as compared to \$10.37 per hour for general labor. We tested twelve temporary labor service invoices from FY 2013 and only one included charges at a supervisor rate, indicating the vendor did not supply a supervisor as required.

Effect:

If a temporary labor supervisor isn't provided as required by the contract, other essential LFUCG personnel located at the MRF must then spend time supervising the temporary labor force rather than performing their other responsibilities. This is a potential breach of contract with the LFUCG that may also result in increased personnel costs for the LFUCG.

Recommendation:

The senior MRF manager recommended in Finding #2 should be given the task of overseeing contracts for the MRF to ensure appropriate compliance. In the absence of this provision, the Director of Waste Management should appoint this task to an existing employee. The Department of Law should be contacted about the potential breach of contract for advice on how to address this issue.

Director of Waste Management Response:

An RFP has been issued and a response is under review that will allow DWM to contract with an outside entity manage and staffing for floor operations related to maintenance, equipment operation. This business model of this company exclusively focused on the operations of MRFs and they are currently providing these services to many of the large MRFs across the United States. Securing their services will allow DWM management staff more time to focus on the oversight of the contract.

Acting Commissioner of EQ&PW Response:

The Department of Law has been contacted to investigate a potential breach of contract but it is the department's observation that such a claim could be compromised by what appears to be a cognizant failure by MRF management staff to enforce certain terms of the contract.

In conjunction with the response provided in Finding #5, the department expects to conclude negotiations with a new contract operations vendor within the next 60 days. Key to the success of this vendor is a revamped internal management structure designed to monitor contract performance and costs so that underperformance and excessive overtime can be mitigated.

Finding #9: Updated Contracts Needed With BRRC and Other Affiliates
Priority Rating: High**Condition:**

For several years, the MRF has employed the services of the Bluegrass Regional Recycling Corporation (BRRC) to act as a broker for commodities sales, excluding aluminum cans. BRRC manifests used at the MRF indicate the type and amount of commodity sold, and BRRC negotiates the price, typically on a monthly basis. BRRC receives payment from the buyer, deducts a \$7 service fee for each ton sold on behalf of the LFUCG and affiliates, and then pays the LFUCG and affiliates their share of the revenue. In addition, multiple affiliates bring their recycled commodities directly to the MRF for processing and subsequent sale to buyers. LFUCG receives a \$35 per ton processing fee from each affiliate as part of their revenue share.

Contracts either could not be located or otherwise do not exist between LFUCG and BRRC or the affiliates. It is our understanding discussions concerning the elimination of BRRC as a broker are occurring. However, even if BRRC is eliminated, affiliates will continue to bring their recyclables to the MRF for processing and the need for contracts with those affiliates will continue to exist.

Effect:

Properly executed contracts provide performance specifications, reduce potential misunderstandings between parties, and limit legal liabilities.

Recommendation:

If the MRF continues to use the broker services of the BRRC, a contract between the two entities should be established which outlines fees, charges, expectations concerning market prices, any other services offered by BRRC, and defines the legal duties of both

the LFUCG and the BRRC. If the MRF eliminates the BRRC as broker, the accountant recommendation in Finding #3 will take on greater significance as the accountant will likely be needed to work with the Commodities Marketing Manager to manage the sale of aluminum cans and the other commodities.

Regardless of the decision concerning BRRC, contracts are needed with all current and future affiliates that define items such as fees charged by LFUCG, sharing in inventory losses resulting from fire or damage, penalties imposed by LFUCG should an affiliate load contain a disproportionate share of glass or trash, limit LFUCG's legal liabilities, etc.

Director of Waste Management Response:

A draft memorandum of agreement has been prepared and is being sent to the Department of Law for review. The MOA will address the issues mentioned in the recommendation above. The plan is to present the agreement to the outside haulers after the proper protocols have been established per the outside accountant's report.

Acting Commissioner of EQ&PW Response:

The department concurs with the division's recommendation. The Department of Law's review of the MOA is expected to be complete in the very near future. The schedule for completing the accounting protocols is 45 days after receipt of the MOA from Law.

Finding #10: May and June 2013 Reports From BRRC for Commodities Sold Contained Discrepancies

Priority: High

Condition:

While reviewing May and June 2013 marketing reports generated by the BRRC to summarize activities, including the amount of revenue LFUCG and each affiliate received for the preceding month's shipments, we noted the broker fee received by BRRC was based on inbound tonnage for the LFUCG and all affiliates rather than outbound tonnage sold by BRRC resulting in an overpayment of broker fees to BRRC of \$9,341 for LFUCG's portion.

We also noted that only 200 tons of glass (in May 2013) and 100 tons of glass (in June 2013) were charged back to affiliates at \$15 per ton as part of the LFUCG processing fee when the total tons of glass was actually 651.78 tons and 462.49 tons, respectively. Upon inquiry, we discovered the May report was the first report where all affiliates were charged for glass shipments. Previously, only three affiliates were charged a processing fee for glass under the assumption no other affiliates had glass mixed in with their inbound loads, and no affiliates were charged for trash processing until the May 2013 report was issued.

Glass has a limited market and LFUCG currently pays to ship all glass to a vendor in Dayton, Ohio at a cost of \$15 per ton, a practice started in January 2013. Prior to January 2013, LFUCG paid \$10 per ton to ship about one-half of the glass to a vendor, and therefore a significant amount of glass accumulated on-site since only about one-half was shipped. MRF management decided to charge affiliates for only 200 and 100 tons respectively, in the first two “new” reports (May and June 2013) since this was the first time most affiliates were charged for glass shipments. The Director of Waste Management could not recall if he was informed of this decision. Affiliates were charged the full amount for their glass beginning in July 2013.

Effect:

LFUCG was bearing a larger burden of the cost for glass and trash than necessary. The MRF was also overcharged broker fees of \$9,341. BRRC refunded the MRF on the next BRRC report after we brought this to MRF management’s attention.

Recommendation:

All future BRRC reports should be carefully analyzed for proper calculations and revenue sharing. Any decisions concerning charges to affiliates should be approved by senior management and properly documented.

Director of Waste Management Response:

A two deep review of the commodity transaction is being established with both the Commodity Marketing Manager and the Accountant being involved in the review.

Acting Commissioner of EQ&PW Response:

The department concurs with the division’s response and also recommends that the action plan be expanded such that the recommended Plant Manager position (Finding # 2) has an accountable role in commodity transaction report accuracy.

Finding #11: Production Reports Should be Reinstated

Priority Rating: High

Condition:

MRF personnel completed daily production reports using Excel and submitted them to the Division Director and others between February 16, 2010 and June 24, 2013 (the last date a production report was prepared and submitted). Beginning on June 25, 2013, the Program Manager Senior completely overhauled the report format. The employee responsible for completing and submitting the reports noticed issues with the new report format and on July 17, 2013, sent an email to the Program Manager Senior asking for

assistance. On August 28, 2013, the Program Manager Senior sent an email stating corrections to the report had been made. On September 5, 2013 the employee responsible for completing and submitting the reports once again expressed concerns over the validity of the reports. On September 23, 2013 the Program Manager Senior sent another email stating additional corrections had been made. As of the end of field work, upper level management had not inquired as to why a production report hasn't been sent since June 24, 2013.

Between the issuance of the September 5, 2013 and September 23, 2013 emails, we met with the Commodities Marketing Manager, the Scale Operator, and the Public Service Supervisor Senior (plant operations manager) to discuss the issues with the production reports. At that meeting, the Public Service Supervisor Senior instructed the Scale Operator to use the previous report format and scrap the overhauled report. Since an email was sent by the Program Manager Senior afterwards about using the overhauled production report, conflicting directives have been given to the employee.

Effect:

Given the unique characteristics of a manufacturing operation, productions goals should be established and every attempt made to reach those goals. Production goals for the MRF are 20 tons per hour of baled commodities, or 84% efficiency, which is considered normal. Without the production report, it would be difficult to determine if this goal is being met.

Recommendation:

A senior management individual (perhaps at the Deputy Director level) should be given the task of getting the production reports back on schedule. A decision is needed immediately on which report to use and this information should be provided to the employee responsible for completing and submitting the reports. The senior management individual (perhaps at the Deputy Director level) should also monitor the reports to make sure goals are set and are being met. Otherwise, the Director of Waste Management should assign this task to another employee.

Director of Waste Management Response:

Production reports were returned to their original format last month. Review will be part of the Resource Management's Program Manager Senior's responsibilities.

Acting Commissioner of EQ&PW Response:

The department concurs with the division's response regarding the production report format. The department concurs with the division's response regarding the review responsibility only as an interim measure.

As stated previously, the department recommends the hiring of a Plant Manager who possesses the skill set necessary to manage a manufacturing facility such as the MRF. The Program Manager Sr. referenced in Condition #11 has resigned and an acting Program Manager Sr. is currently in place as upper level management further evaluates the situation and develops an action plan moving forward.

The development of a firm schedule for completing the Plant Manager hiring process is difficult at this time due to the division director vacancy. It is the department's recommendation that recruitment of the division director come first so that the new director can play an active role in the selection of a Plant Manager. The advertisement for the vacant division director was posted January 15, 2014 and is scheduled to close February 16, 2014.

Finding #12: Additional Issues Noted During the Audit
Priority: High

Condition:

During discussions with MRF employees, two additional items were noted that warrant being included in this report: 1) voided BRRC manifests are sent back to BRRC but no record of them is kept; and 2) trucks that have Radio Frequency Identification (RFID) don't always stay on the scale long enough for the weight to register in the computer.

Regarding the first issue, manifests are the primary source of information for shipment of commodities from the MRF. Currently, as noted in a previous finding, BRRC acts as the broker for LFUCG and all other affiliates for all commodities sold excluding aluminum cans. LFUCG uses its own manifest for aluminum can shipments. Manifests should be used in sequential order, and any unused manifests should be voided with a record of this action retained. We informed the Scale Operator of this issue during the audit, and a list of voided BRRC manifests is now being kept.

Regarding the second issue, the scale management system currently used at the MRF was updated in June 2010 and has the capability to read and upload the owner and weight of any RFID truck that drives across the scale, provided the driver stays on the scale long enough. A red and green light was installed that visually alerts the driver on when to stop and when to drive off the scale. However, drivers are moving off the scale before the light turns green.

Effect:

Shipments can be lost if manifests are not accounted for properly. The daily inbound and outbound tonnage, which is calculated using the weight of the trucks, can be incorrect.

Recommendation:

A copy of all voided manifests being sent back to BRRC should be retained at the MRF, along with any manifests voided by the LFUCG. An electronic arm should be installed on the scale that indicates when it is safe for the driver to move off the scale.

Director of Waste Management Response:

It is the intention of DWM management to internalize the services of the BRRC after the appropriate protocols have been established for managing the processes of shipping receivables and disbursements. This will address the issue of the voided manifests. DWM staff will explore the feasibility of installing an automated arm at the truck scale.

Acting Commissioner of EQ&PW Response:

The acting division director is pursuing Internal Audit's recommendations.

Risk Mgmt Recommendation From 2012 ~ 2013 Investigations

Item #	Finding by Risk Management - Recommendations	Corrective Action Taken	Outstanding Issues to be Resolved	Next Steps/Results	Current Status
New #1	Signage requiring hardhats have been installed on each side of the tipping floor. The signs however are small and are not easily noticed or read from a distance or the center of the room. A driver was observed not wearing a hardhat while standing under the opened rear compartment of their truck. Larger signage is recommended. It is also recommended that all LFUCG drivers be trained on the safety rules for the MRF tipping floor operations.	Some larger signage has been placed on tipping floor area for hardhat requirement. Non-Compliance by drivers is reported to Richard Boone, Program Manager, Sr. at DWM	Add more signage as might be necessary in future. More training on procedures on an on-going basis with drivers entering facility tipping floor.	Keep Rules Updated for any changing conditions that may arise and add signage as needed by end of February.	Monitoring situation with drivers for what has been put into place thus far.
New #2	During the site visit, it was pointed out that we currently have tours walking through the tipping floor operations. Having large groups of people on the tipping floor introduces additional dynamics that have to be managed against the current safety challenges for this area. This can be especially difficult with younger children or teens when traffic is heavy. For this reason, it is recommended that the lower panel of north metal wall be replaced with a heavy grade plexiglass that will allow observation of the tipping floor to enter from the side entrance and eliminate groups walking through the operational area of the tipping floor.	Tours have been suspended currently. If restarted in the future the tour will be adapted to observe from a safe area on the side through a side door.	Reevaluation of all safety concerns for allowing tours in this area of facility.	Establish procedures and training if tours are to be restarted in future.	Tours Suspended.
1	Develop written safety procedures for the tipping floor operations and ensure that all employees are trained. It is also recommended that the general safety rules inclusive of the truck drivers be mounted on the wall (in large print) near the interior bay doors. Written safety procedures currently do not exist and are not posted in the area.	Tipping Floor Operations Procedures were tentatively in place at the time of this audit by Risk Management. SOP's dated July 9, 2013 were already in process and are in fact a living document. Procedures were reviewed with employees/temporary labor while some signage may still be needed on rules.	Signage with Rules to be made and installed once reviewed for final procedures.	Review Tipping Floor Rules, Order any more necessary signs, have signs installed.	To be completed by mid to late February.

2	To improve general safety, it is recommended that a maximum height line be painted approximately a foot or two below the top of the metal interior wall. On the day of the job safety analysis recyclable material piles exceeded the height of the interior metal walls which compromises the protection provided by the walls for walkways immediately behind.	Examining various options to fulfill this recommendation currently underway and a final solution will be implemented by mid to late February.	Examine all options to accomplish this demarkation of the height of materials on tipping floor.	Consider all options available. Chose the best options and put one or more in place.	To be completed by mid to late February.
3	Floor workers and the driver of the front end loader should engage established eye contact and specific hand signals to improve communications and to confirm location of floor workers prior to moving the heavy equipment. It should be noted that both floor workers were equipped with shoulder mounted radios and capable of communicating with the driver of the front end loader, as needed. However, eye contact and positive signaling should be a mandatory inclusive practice of confirming employee safety on the tipping floor. On day of USA, employees indicated that there was no formal training or hand signaling techniques currently being used within the scope of the operations.	These recommendations were part of the SOPs instituted on 7/9/13 and employees were trained on hand signals afterward.	Review current procedures for any needed corrections or additions and retrain all workers again on procedures as an update on them.	Review, update, & retrain.	Updates and retraining to be completed by mid to late February.
4	"No Zones" should be established within the operations of the tipping floor area. No zones typically exclude working within the turning radius of the front end loader, never crossing in front of or behind the wheel path of the equipment and being aware of and avoiding blind spots of the driver. All these areas are considered "No Zones" and should be avoided at all times. On the day of the analysis, employees worked in close proximity to the heavy equipment and violated several of these basic safety principals.	Only the employee directing trucks onto the tipping floor and one located near the drum feeder area are in the immediate area of moving vehicles and heavy equipment and use radios, hand signals, and air horns for communication with the driver/operator of vehicles and equipment. Workers and Driver/Operators have reviewed the procedures put into place.	Review current procedures for any needed corrections or additions and retrain all workers again on procedures as an update on them when necessary to do so.	Review, update, & retrain as necessary.	Updates and retraining to be completed by mid to late February.

5	When employees approach the front end loader, usually to remove non-desirable materials from the bucket, additional safety provisions should be established and followed. Suggested considerations include: (1) put the front loader in neutral, (2) lower the bucket to the ground to enable the driver to see ground workers, (3) do not engage the reverse or forward gear of front loader until employees have cleared the immediate turning radius of equipment and have established positive eye contact and hand signal is confirmed.	Workers will approach bucket of end loader when it has been set upon the ground and vehicle is in neutral gear with eye contact to operator before removing any materials from bucket. Procedures have been reviewed with workers and driver/operators.	On a quarterly or semi-annual basis review the procedures and monitor regularly for compliance with set procedures. Update them as necessary and retrain workers on any changes made to them.	Review, update, & retrain as necessary.	Procedures are in place and to be monitored along with routine updates and retraining as needed.
6	The high visibility/retro reflective traffic vest being worn by the temporary employees were dirty and did not achieve the intention of the ANSI standard. It is recommended that the employees working the floor be provided new traffic safety vest (ANSI Class III).	Traffic Safety Vests (ANSI Class III) are being kept cleaner and newer ones issued to workers more often (weekly if needed) by labor subcontractor. DWM will assist with supplying new vests as needed as well.	N/A	Continue monitoring condition of vests in use within the facility.	Procedures seem to be working much better now than in past.
7	Due to the continued need to communicate while working on the floor, a "band" styled hearing protector may be a good alternative for employee's working the tipping floor area. On the day of the JSA, both floor workers were observed wearing the insert plugs improperly (inserted sideways), which yields ineffective results and provides no hearing protection to the workers.	Various types of ear plugs and other hearing protection have been made available and DWM will continue to try newer advancements in hearing protection as it becomes available.	Evaluate issuance, proper use, and replacement of hearing protection on a regular basis.	Monitor use and availability of supplies of hearing protection to keep varieties in stock and readily available to workers.	Procedures seem to be working much better now than in past.
8	Employees should be equipped with a loud noise device (whistle and/or air horn) capable of garnering the attention of all drivers, if needed.	Air Horns have been purchased and made available to key areas within the facility attached to the workers vests for immediate access as may be needed.	Review current procedures for any needed corrections or additions and retrain all workers again on procedures as an update on them.	Monitor supplies, Review, update, & retrain on procedures as necessary.	Procedures seem to be working much better now than in past.

9	Floor workers should always approve trucks entry onto the tipping floor and maintain control of the floor at all times. For this reason it is recommended that each bay door be equipped with a braded retractable safety strap that can be used to temporarily close off access across the bay door if the worker needs to engage in activities where off-loading/dumping might otherwise compromise their safety.	See #4 above and SOPs dated 7/9/13 that have addressed this issue. Further study is needed on closing off bays while servicing those floor areas. A strap to close off the bay doors could become very time consuming and not function properly in extremely cold/wet/snow/icy conditions as well. Also with the frequency that they may need to be closed another method may need to be implemented. DWM will work with Risk Management on the best solution to this situation.	Best method for closing off a bay while other activities are on-going in that area.	Reevaluate all options and select one best suited for the situation in consensus with Risk Management staff.	To be completed by mid to late February.
10	It is recommended that strobe lights or beacons be installed in the tipping floor which the floor workers can activate by a push button in the event of an emergency where all equipment needs to be alerted to immediately stop moving. This is important due to the fact that floor workers are vulnerable to the constant dynamics of the floor operations and moving equipment and may need to harness the attention and safety of the entire area at once.	Air Horns have been purchased and made available to key areas within the facility attached to the workers vests for immediate access as may be needed to serve this function.	Further examination of something similar to a medical alert device where the push button is worn on a break-away lanyard around the neck and when pushed activates an alarm and strobes within that area of the facility.	Reevaluate all options and select one best suited for the situation in consensus with Risk Management staff.	To be completed by late February.
11	The height bars hangin above the bay doors should be moved inward to the tipping floor area approximately 5-8 feet and be equipped with cow bells on either side of the bar. This would better serve to provide advance warning to drivers of their potential for contacting the top of the bay doors. Current placement is ineffective.	Currently considering a light curtain type of device that would be much more effective and when the light beam is broken it would set off a horn/light at the doors to warn drivers to stop in case they leave their tailgates up in the air higher than the door openings.	Get pricing and installation estimates on light curtain and/or other warning devices for this purpose.	Reevaluate all options and select one best suited for the situation in consensus with Risk Management staff.	To be completed by late February.

12	It is recommended that an "unplugging area" of some type be installed in the parking lot that trucks use to dislodge compacted loads without backing up traffic and hindering efficiency of the operations. Current unplugging techniques of opening the rear of the trucks, raising the compartments, and speeding forward, hitting the brakes, and hoping the load falls out, introduces an unnecessary safety dynamic (hazard) into the tipping floor area.	The former process has been suspended on the tipping floor and the truck is to be moved out into a safer area within the parking lot to use another means of unlogging the materials stuck in the hopper of the truck. This may include calling in additional DWM or other resources to assist with the unlogging away from the tipping floor operations. DWM violators will be reported to Richard Boone, Program Manager, Sr and outside vendors will have their companies notified as well via email.	The hazardous activity has been moved off of the tipping floor area and out into the parking lot in a much safer location for now. This will allow the operation to continue and not back-up trucks waiting to unload.	Continue to study and reevaluate this procedure of "unplugging" appropriately into the future.	On-going monitoring and updating as necessary.
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2013 Urban Tree Canopy Assessment and Planting Plan

Urban Service Area in Fayette County, Kentucky
Lexington-Fayette Urban County Government



Benefits of Urban Tree Canopy

Public and private trees are assets to community health, safety, and livability.

- Trees bring people together and encourage community pride.
- Trees are calming and encourage active lifestyles.
- Trees provide food and shelter for people and wildlife.
- Trees increase property values.
- Trees improve shopping experiences and frequency of visits.
- Trees manage stormwater runoff, acting as tiny reservoirs.
- Trees improve water quality and habitat in streams and lakes.
- Trees cool air, temperatures around streets, parking lots, and homes.
- Trees conserve home cooling and heating usage.
- Trees filter pollutants out of the air improving air quality.
- Trees take carbon dioxide and provide oxygen.



Project Purpose

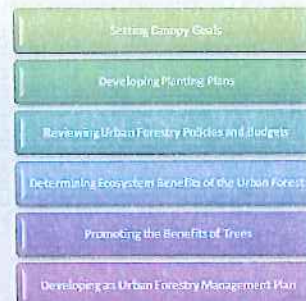


Lexington's Urban Service Area Tree Canopy Assessment and Planting Plan

Purpose:

- (1) Assess Lexington's current (2012) tree canopy area
- (2) Identify preferred tree planting priority locations
- (3) Analyze ecosystem benefits of existing and increased canopy
- (4) Provide LFUCG staff tools to manage and track the urban tree canopy over time

Results of the UTC Assessment will assist Lexington manage and grow the urban forest.



Project Scope



Objectives:

- Establish UTC baseline information that can be used to track canopy gains and losses over time.
- Quantify the benefits of the existing and future community forest resource.
- Develop a prioritized planting plan based on environmental factors that support the overall project goals.

This presentation contains some of the results from a more thorough report following these areas of interest:



Urban Tree Canopy Assessment



Tree canopy is a layer of leaves, branches, and stems of all public and private trees that cover the ground when viewed from above.

A UTC assessment uses aerial photographs and satellite imagery with geographic information systems (GIS) data to:

- capture existing tree canopy, and
- identify target areas for planting trees within a defined geographical boundary.

Land cover classifications aid in establishing possible tree canopy and determining potential locations for planting sites.

5 Basic Classifications of Land Cover



Tree Canopy
Impervious Surfaces
Grass/Low-Lying Vegetation
Bare Soil
Open Water

Detailed Classifications of Land Cover



Buildings
Roads
Other Impervious
Additional Layers
•Agricultural
•Wetlands
•Developments

Lexington's Existing Urban Tree Canopy



Within Lexington's Urban Service Area of 54,630 acres (85.36 square miles):

1. Urban Tree Canopy (2012) is 24.56%.
2. The UTC increased by +5.4% in 18 years (1994 to 2012).

UTC Assessment Results

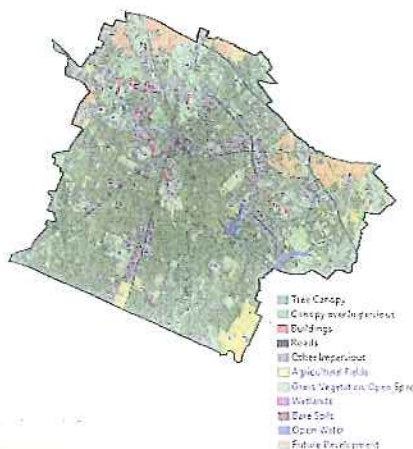
Land Cover Classification	Urban Tree Canopy Assessment (%)		
	1994	2012	% Change
Tree Canopy	19.20	24.56	+5.4
Impervious Surfaces*	30.50	34.34	+3.8
Grass & Low Vegetation**	49.50	39.30	-10.2
Bare Soils**	0.40	0.76	+0.4
Open Water***	0.40	1.03	+0.4

* Impervious surfaces include buildings, roads, houses, and parking lots.

** Bare soils include ball fields, non-vegetative ground, construction sites.

*** Open water includes lakes, reservoirs, ponds, and large rivers.

Land Cover Classification of Lexington's Urban Service Area



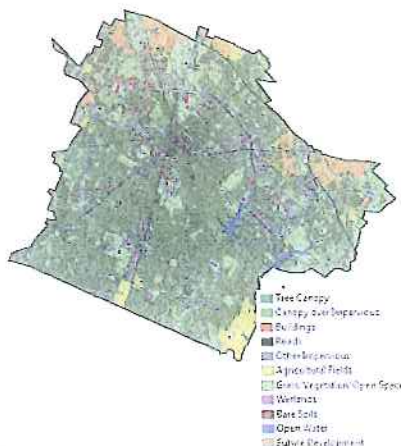
Lexington's Existing Urban Tree Canopy



UTC Assessment Results by Council District

Council District	District Total Acres	Canopy Acres	% Canopy Cover
1	4,408	953	21.6%
2	7,005	1,259	18.0%
3	2,609	637	24.4%
4	3,396	1,084	31.9%
5	4,647	1,410	30.3%
6	5,778	1,301	22.5%
7	4,662	1,013	21.7%
8	2,835	819	28.9%
9	4,324	1,150	26.6%
10	4,397	1,160	26.4%
11	3,393	1,012	29.8%
12	7,174	1,622	22.6%
Totals:	54,630	13,420	24.56%

Land Cover Classification of Lexington's Urban Service Area



Existing UTC Ecosystem Benefits



Annual Ecosystem Benefits Results

Lexington's existing tree canopy provides annual stormwater, carbon, and air pollution benefits valued at \$30,594,735.



AIR

- 1,122,200 pounds of pollutants removed annually
- \$4,028,507 annual ecosystem benefit



CARBON

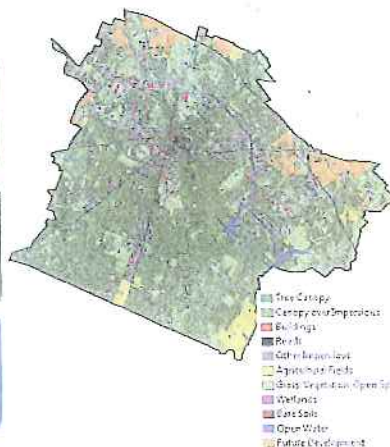
- 505,310 tons of carbon pulled from air and stored annually
- \$11,557,552 annual ecosystem benefit



WATER

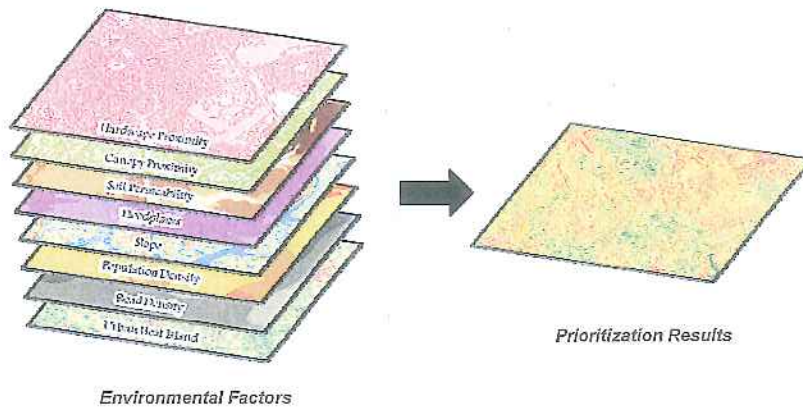
- 258,246,548 gallon reduction in stormwater runoff
- \$15,008,676 annual ecosystem benefit

Land Cover Classification of Lexington's Urban Service Area



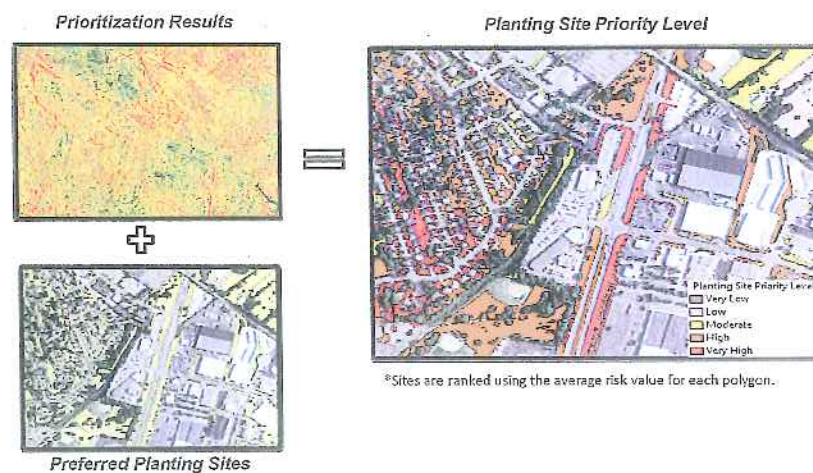
Increasing the Urban Tree Canopy with a Prioritized Planting Plan

DAVEY
RESOURCE GROUP
Sustainable Infrastructure



Prioritized Planting Plan

DAVEY
RESOURCE GROUP
Sustainable Infrastructure



Develop Tree Planting Plans



GIS-based tools are used to map the boundaries of each preferred planting area by priority rating.

<i>Priority Rating</i>	<i>Planting Acres</i>
Very High	1,223 ac. 7.6%
High	4,833 ac. 30.1%
Moderate	5,868 ac. 36.6%
Low	3,689 ac. 23.0%
Very Low	427 ac. 2.7%



Tree Planting Plans



Cooperative Efforts

Preferred planting sites exist on both publically and privately owned property. Increasing urban tree canopy requires a cooperative effort among property owners, community organizations, neighborhood groups, businesses, and state and local governments to produce a significant result.

Lexington's Priority Planting Site Ownership

Ownership:	Government (State/Local)	Private
% of Priority Planting Sites	16%	84%

Prioritized Planting Areas by Council District

Council District	District Total Acres	Prioritized Area Acres	% of District Acres
1	4,408	1,440	32.7%
2	7,005	2,234	31.9%
3	2,609	602	23.1%
4	3,396	996	29.3%
5	4,647	1,140	24.5%
6	5,778	1,614	27.9%
7	4,662	1,705	36.6%
8	2,835	920	32.5%
9	4,324	1,329	30.7%
10	4,397	1,497	34.0%
11	3,393	977	28.8%
12	7,174	1,800	25.1%
Totals:	54,630	16,253	29.75%

Tree Canopy Management Tools



1. GIS-based Tree Planting Prioritization Plan with Tree Planting Sites Identified with Attributes



Tree Canopy Management Tools



2. Canopy Cost Calculator

The Urban Tree Resource Analysis and Cost Estimator (UTRACE) can utilize the UTC data to estimate the trees required and costs to increase and maintain canopy within the Urban Service Area.

For each 1% increase in Lexington's tree canopy, approximately \$1.2 million in tree planting would be needed, as well as additional investments in maintenance.



How to Use the UTC Assessment



Results of the UTC Assessment will assist Lexington in managing and growing the urban forest.



Next Steps Focus?



(1) Urban Forestry Management Plan

(2) At-risk trees

- Street trees
- LFUCG properties

(3) Public/Private Partnerships

- Tree Board/Lexington Tree Foundation
- Reforest the Bluegrass/Arbor Day
- Neighborhood grants coordination
- Outreach on Urban Tree Canopy using new UTC management tools

(4) Interdepartmental Coordination

- Urban Forestry Coordination Committee
- Urban Forest Management Plan
- Operation and maintenance
- Tree planting implementation

Results of the UTC Assessment will assist Lexington manage and grow the urban forest.





Urban Tree Canopy Assessment and Planting Plan

Urban Service Area in Fayette County, Kentucky

Lexington-Fayette Urban County Government

October 2013

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C. Environmental and Social Factors
D. Urban Tree Resource Analysis and Cost Estimator (UTRACE)
E. Suggested Tree Species
F. Benefits of the Urban Forest

Introduction

The trees of Lexington's Urban Service Area are a major component of the infrastructure and provide more than the traditional values of aesthetics and shade. They also provide numerous quantifiable environmental benefits, including stormwater management, watershed protection, water quality improvements, temperature moderation and cooling, reduction of air pollutants, energy conservation, and overall increases in property values. The amount of urban tree canopy (UTC) and its location determines the amount and types of economic, environmental, and social benefits provided by trees to the government and the citizens.

Trees contribute greatly to the quality of life in Lexington and—unlike the other components of the community's infrastructure—the tree population, with proper care and protection, will actually continue to increase in value with each passing year.

Over the last 20 years, great advances in quantifying the environmental, economic, and social benefits of the urban forest have been made. Tools are available to community and government stakeholders and managers. These advances have been driven by an increasingly common shift in how communities around the country value their trees and green spaces.

This project provides the Lexington-Fayette Urban County Government (LFUCG) with a current baseline land cover percentage including canopy, assessment of possible UTC and planting areas, and an analysis of ecosystem benefits.

The results of this UTC assessment and prioritized planting plan will be especially valuable for the reasonable, rational, and defensible planning of the Urban Service Area's current and future urban forest and green infrastructure.

The UTC assessment results will assist the Lexington-Fayette Urban County Government in managing and growing the urban forest in addition to:

Setting Canopy Goals

Revising Policies Associated with Tree Canopy

Determining Ecosystem Benefits Provided by the Urban Forest

Promoting the Benefits of Trees

Developing Sound Urban Forest Management Plans

Purpose

The purpose of the project is to use aerial photographs and satellite imagery with geographic information systems (GIS) data to map and analyze the existing UTC and identify target areas for planting trees in Lexington and Fayette County's Urban Service Area. Mapping and quantifying UTC will allow LFUCG to establish baseline conditions for current use and future monitoring, set goals for improvement, and create plans for planting and protecting trees. Quantifying the benefits of the urban forest will allow LFUCG to promote the benefits of trees and the urban forest to staff, elected officials, stakeholders, and the citizens and gain support for urban forest management, stormwater, and sustainability programs.

Scope

The 2012 National Agricultural Imagery Program (NAIP) leaf-on, multispectral imagery acquired and processed by the US Department of Agriculture (USDA) was used as the primary source to identify Lexington's Urban Service Area current land cover. Remote sensing and GIS software extensions provided the automated feature extraction tool to generate the baseline percentage of the final tree canopy and land cover layer. Ancillary GIS data aided in determining potential planting site locations and established the current overall possible UTC. Land cover areas designated as canopy, pervious, or bare soils was considered in the calculation of possible UTC. Land uses designated as interstate corridors, highways, streets, open space, residential lots, or parks were identified as target areas for tree planting and canopy growth and was included in the analysis. Conversely, land uses designated as agricultural land, cemeteries, golf courses, utility rights-of-way, or recreational fields were defined as unavailable for future planting and excluded from the analysis. Prior to implementing this planting plan, further and more precise assessment by LFUCG or any other organization utilizing this information for selecting potential planting sites is needed to determine the presence of other land use constraints and whether the land is truly appropriate for planting trees.

The project objectives include: identifying and quantifying the current contributions of urban trees by establishing UTC baseline information that can be used to track canopy gains and losses over time; developing a prioritized planting plan based on environmental factors that support the overall project goals; and determining the benefits of the future forest.



Urban Tree Canopy Assessment

The results of the 2012 UTC assessment are provided in Table 1. The boundary of Lexington's Urban Service Area covers approximately 54,630 acres (85.36 square miles) (Figure 1). Based on the UTC analysis results, the estimated canopy coverage of this study area is 24.56%. Several methods were used to quantify the 2012 existing UTC. Further results of this UTC assessment are provided in the following sections of this report and the methodology and accuracy assessment documentation are presented in Appendix A.

Table 1. Existing UTC Assessment Results
in Lexington's Urban Service Area

Land Cover Class	Acres	Percent
Tree Canopy	13,420	24.56%
Impervious Surfaces	18,763	34.34%
Pervious Surfaces	21,470	39.30%
Bare Soils	416	0.76%
Open Water	560	1.03%
Total	54,630	100.00%

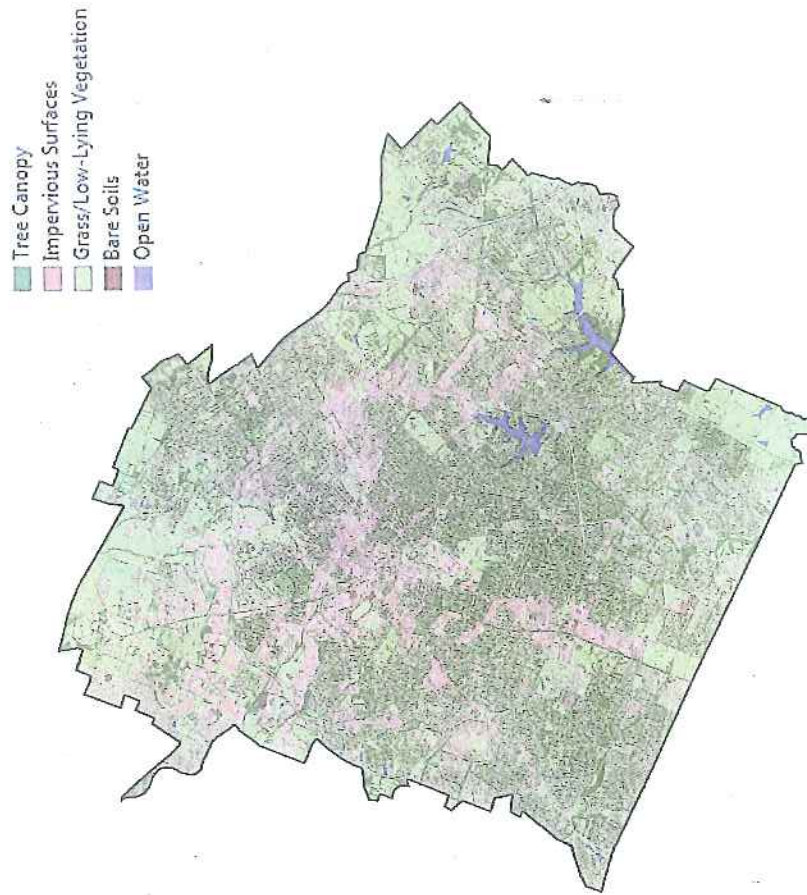


Figure 1. Visual results of the 2012 Urban Tree Canopy Assessment
in the Urban Service Area of Lexington, Kentucky.

Detailed Land Cover Results

The results of a more detailed UTC assessment are provided in Table 2. Pervious and impervious surface were identified further using the five-class land cover layer and other available GIS layers to illustrate more realistic views (Figure 2). Pervious surfaces were assessed in greater detail to represent the true nature of Lexington's landscape and include grass/vegetation/open space, agricultural fields, wetlands, and future development. Impervious surfaces were assessed in greater detail to give statistics on the current amount of pavement and include canopy over impervious, buildings, roads, and other impervious.

Table 2. Detailed Land Cover Assessment
Results in Lexington's Urban Service Area

Land Cover Class	Acres	Percent
Tree Canopy	11,679	21.38%
Canopy over Impervious	1,827	3.35%
Buildings	6,181	11.31%
Roads	4,500	8.24%
Other Impervious	7,842	14.35%
Agricultural	1,397	2.56%
Grass/Vegetation/ Open Space	17,788	32.56%
Wetlands	26	0.05%
Bare Soil	415	0.76%
Open Water	560	1.03%
Future Development	2,415	4.42%
Total	54,630	100.00%

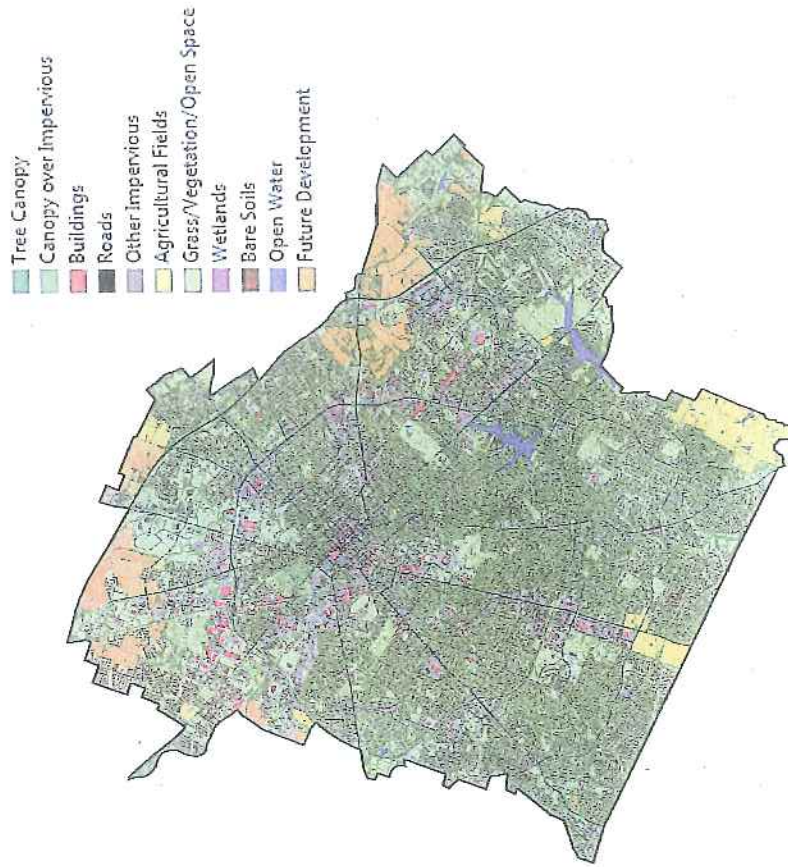


Figure 2. Visual results of the 2012 Detailed Land Cover Classification
in the Urban Service Area of Lexington, Kentucky.

i-Tree Canopy Analysis

Davey Resource Group compared the existing land cover percentage values with the statistical results generated from i-Tree Canopy to determine the project area's historical land cover percentage values.

The i-Tree Canopy tool (Figure 3) allows users to easily interpret Google Earth aerial imagery for areas of interest and produce statistical estimates of tree cover and other cover types. Calculation of estimate uncertainty is provided as well. This tool provides a quick and inexpensive means for communities, government stakeholders, urban forest managers, and non-profits to accurately estimate tree canopy cover.

This i-Tree Canopy tool can be used by LFUCG in future land cover assessments to provide land cover analysis using new aerial images as they become available in Google® Maps. The random point locations derived from i-Tree Canopy can be re-imported in future works to produce a statistically valid estimate of land cover. The i-Tree Canopy data were provided along with this report on CD-ROM. LFUCG can use this tool to quickly evaluate canopy effects after future severe weather events, increased development, and collective planting efforts.

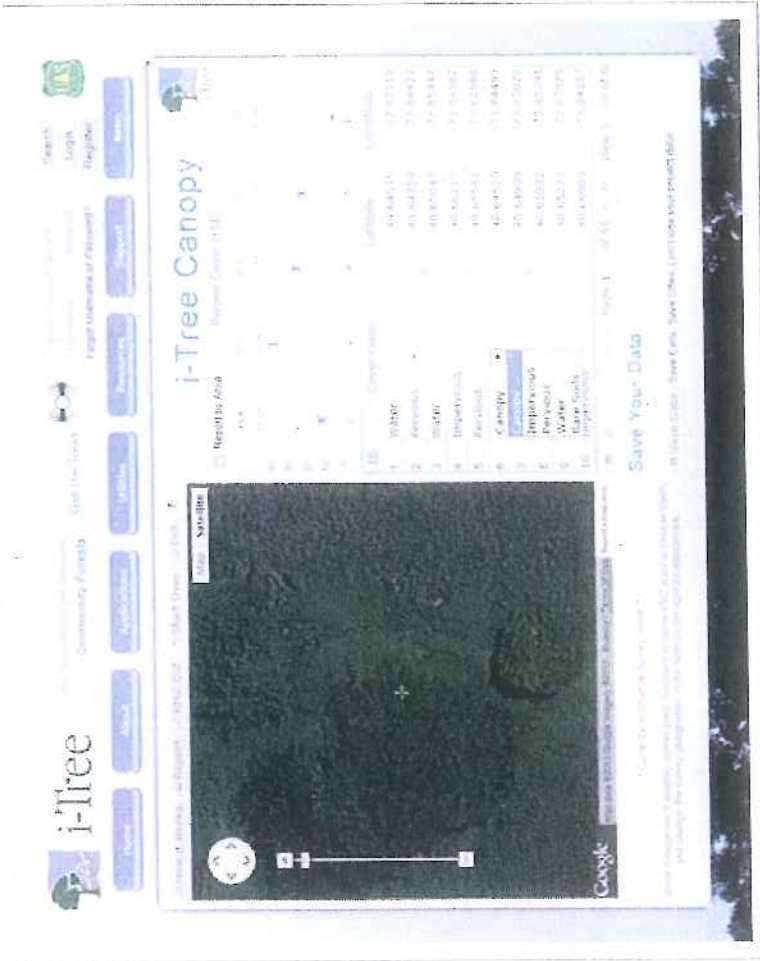


Figure 3. Screen shot of i-Tree Canopy interface.

Historical Land Cover Change Assessment

Davey Resource Group generated a Google® Earth KML file of the random point locations derived from i-Tree Canopy analysis for the project area to complete a statistical canopy assessment for two additional years. Davey Resource Group performed a historic UTC change assessment for Lexington's Urban Service Area using images from March 1994 and June 2004. Figure 4 illustrates land cover change from grass or low vegetation and a single impervious road to buildings, parking lots, and more impervious road surface areas.

Results of the land cover change analysis from 1994 to 2012 are reported in Table 3. Over an 18-year period, Lexington's tree canopy coverage has increased by 5%, impervious surfaces have increased by 4%, and pervious surfaces have decreased by 10%. The increase of tree canopy cover—attributed to the growth of existing trees and the addition of new trees—is helping to mitigate the negative trend of losing pervious surfaces.

Table 3. i-Tree Canopy Results
in Lexington's Urban Service Area

i-Tree Canopy Assessment (%)				
Land Cover Class	1994	2004	2012	% Change
Tree Canopy	19.20	21.00	24.56	5.36
Impervious Surfaces	30.50	34.90	34.34	3.84
Pervious Surfaces	49.50	40.10	39.30	-10.20
Bare Soils	0.40	3.59	0.76	0.36
Open Water	0.40	0.40	1.03	0.63



Figure 4. Example of land cover change from March 1994 to June 2004 to June 2012.

Urban Tree Canopy Goals

The amount of tree canopy drives the amount of benefits that an urban forest provides. Whether LFUGG wants to increase or maintain tree canopy, setting goals will help organize tree planting programs and inform tree preservation efforts. Establishing realistic and achievable tree canopy goals will help capitalize on the economic, environmental, and social benefits trees provide to the community. Appendix E provides a planting list that offers smart choices for species selection and diversity to build a resilient urban forest that will not be greatly affected by any single invasive pest or disease.

“Possible UTC” is the result of all land cover that is open, pervious ground. While it is theoretically possible that all pervious surfaces could be planted to increase future tree canopy, considering all land use areas is understandably not practical for implementing actual planting projects nor is it realistic for urban forest planning and management.

“Preferred UTC” or “future planting area” is based on a “real world” approach to the identification of reasonable areas to plant trees. Davey Resource Group assessed and prioritized these areas based on maximizing ecological services, providing equal access to trees and natural resources, and protecting public health and safety benefits. Preferred planting areas include the pervious surfaces within interstate corridors, highways, streets, and parks within Lexington’s Urban Service Area. Land uses such as agricultural land, cemeteries, golf courses, utility rights-of-way, and recreational fields were excluded from the analysis.

Many communities have set canopy coverage goals, standards, or policies. One of the most widespread uses of UTC technology is to set canopy coverage goals. American Forests, a recognized leader in conservation and urban forestry, has established canopy goals for metropolitan areas. American Forests’ goals are an accepted standard and can be used as a general guideline or target for communities to achieve. While tree cover will vary across a city, American Forests recommends cities set a canopy cover goal of 40% overall—the equivalent of 20 large trees per acre. Lexington’s amount of existing tree canopy is 25%; the realistic estimate of tree canopy is 30% within preferred planting areas; and the true maximum tree canopy is 55%. Maximum potential is the sum of existing UTC and possible UTC based on the findings of this assessment (Figure 5).

Individual UTC assessment summaries for geographical areas identified by LFUGG are included in Appendix B.

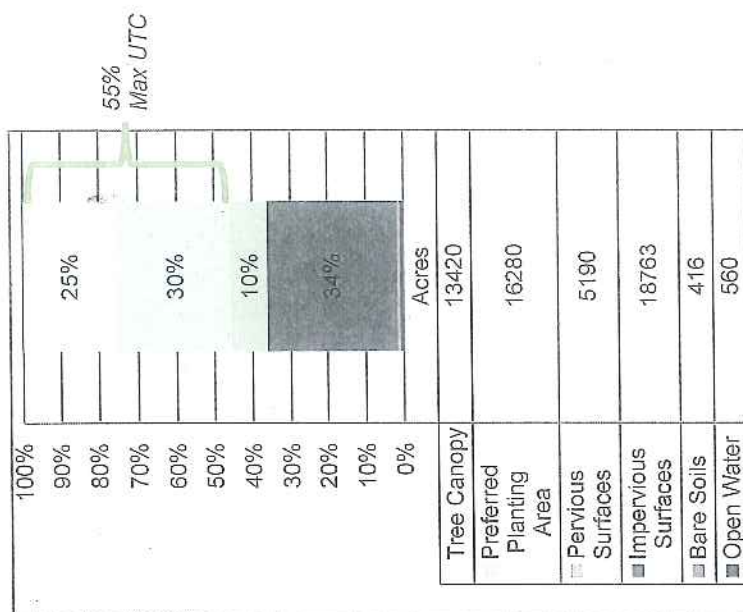


Figure 5. Maximum urban tree canopy cover within Lexington’s Urban Service Area.

Ecosystem Benefits Analyses

Trees conserve energy, reduce carbon dioxide levels, improve air quality, and mitigate stormwater runoff (Figure 6). In addition, trees provide numerous economical, psychological, and social benefits.

The ecosystem benefits of Lexington's UTC resource were quantified using the latest version of the i-Tree Vue 4 model and TR-55 hydrologic equations. i-Tree Vue estimates carbon storage and sequestration and air pollutant removal. Air pollutants included in estimates are carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), particulate matter (PM₁₀), and sulfur dioxide (SO₂). TR-55 hydrologic equations model stormwater runoff. The following is an explanation of each analysis.

Air Quality: The publically accessible software model called i-Tree Vue uses National Land Cover Data (NLCD) satellite-based imagery to assess a project area's land cover. The software supports analysis of pollution removal from different land classes (including tree canopy). Recent innovations with the latest version of i-Tree Vue have allowed for the adjustment of the NLCD tree canopy and impervious cover values overall within the software model to generate the overall ecosystem service estimated values. Reports quantify the monetary and unit values of pollution reduction.

Carbon: The software model i-Tree Vue can again provide the solution to evaluating the carbon sequestration and storage services provided by the project area's UTC. Along with the air quality analysis, the software was calibrated with the current land cover and impervious surface percentages to model the urban forests' carbon benefits. Results demonstrate the amount of UTC directly correlated to current and future increases in carbon reduction.

Stormwater: A stormwater assessment was completed using the TR-55 hydrologic equations created by the USDA for modeling stormwater runoff. These equations are commonly used to assess stormwater runoff in urban watersheds by generating a curve number. This number is correlated with hydrologic soil groups which identify a soil's permeability. In addition, the curve number also uses current land cover as an input. To calculate runoff, the equation uses rainfall data, potential maximum retention, and initial abstraction. CITYGreen for ArcView® 3.x software was utilized to quantify the monetary and unit values of pollution reduction and stormwater.

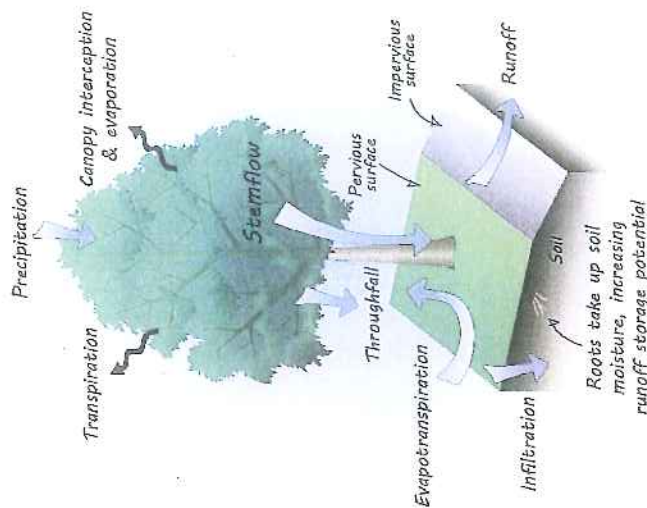


Figure 6. Stormwater benefit process.

Data analysis shows Lexington's existing UTC provides an estimated \$30,594,735 in annual benefits and savings to the community. Figure 7 lists the total ecosystem benefits and illustrates projected ecosystem benefits based on Lexington's current canopy cover extent of 24.56% and the potential benefits from increasing that cover by 5% and 15%. Increasing canopy cover by 5% to 30% is a realistic, short-term achievable goal. Increasing canopy cover by 15% meets American Forests recommended 40% canopy cover for metropolitan areas east of the Mississippi River.

Increasing Lexington's UTC by 5% will produce an increase in benefits and values of nearly 15%. Achieving 30% canopy cover reaches 55% of Lexington's maximum potential for canopy cover given existing conditions. Canopy cover at 40% will produce an increase in benefits and values of nearly 53%. Achieving 40% canopy cover reaches 73% of Lexington's maximum potential for canopy cover given existing conditions.

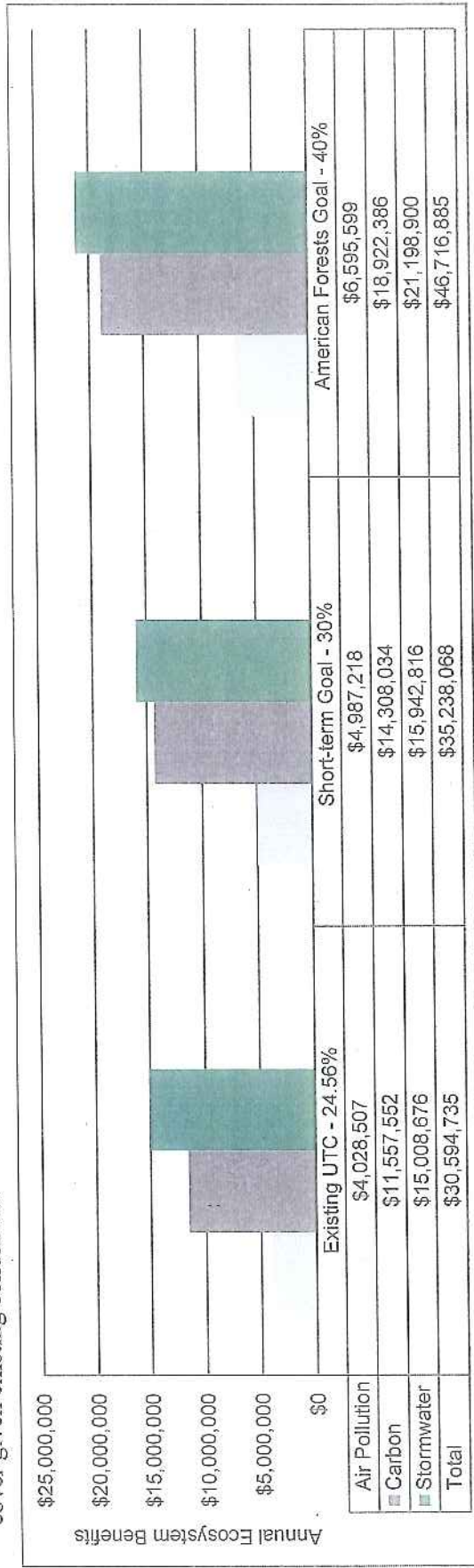


Figure 7. Ecosystem benefits provided by Lexington's urban tree canopy at various UTC percentages.

Lexington's entire urban forest removes 1,122,300 pounds of pollutants from the air annually, a benefit valued at \$4,028,507. Additionally, the community's urban forest stores approximately 490,732 tons of carbon and each year sequesters approximately 16,178 tons of carbon dioxide; these benefits are valued at \$11,188,694 (storage) and \$368,858 (annual carbon sequestration). Trees also intercept over 258,246,548 cubic feet of runoff every year, a benefit valued at \$15,008,676. Table 4 illustrates the total ecosystem benefits that the existing UTC provides to Lexington as well as the estimated benefits provided if the UTC is increased to 30% or 40%.

Table 4. Ecosystem Benefits Provided by Lexington's UTC¹

Ecosystem Factor	Lexington 2012 UTC 24.56%		Lexington at UTC of 30%		Lexington at UTC of 40%	
	Units	Value	Units	Value	Units	Value
Air Pollution (pounds)						
CO ₂	16,000	\$10,274	20,000	\$12,719	26,400	\$16,820
NO ₂	134,400	\$604,342	166,600	\$748,165	220,000	\$989,448
O ₃	498,400	\$2,239,766	617,000	\$2,772,789	81,600	\$3,667,016
SO ₂	129,600	\$142,651	160,600	\$176,599	212,000	\$233,553
PM ₁₀	343,800	\$1,031,474	425,600	\$1,276,946	563,000	\$1,688,762
Subtotal	1,122,200	\$4,028,507	1,389,800	\$4,987,218	1,103,000	\$6,595,599
Carbon (tons)						
Storage	490,732	\$11,188,694	607,517	\$13,851,395	803,442	\$18,318,480
Sequestration	16,178	\$368,858	20,027	\$456,639	26,487	\$603,906
Subtotal	506,910	\$11,557,552	627,544	\$14,308,034	829,929	\$18,922,386
Stormwater (cubic feet)	258,246,548	\$15,008,676*	245,969,777	\$15,942,816*	230,337,477	\$21,198,900*
Subtotal	258,246,548	\$15,008,676**	245,969,777	\$15,942,816**	230,337,477	\$21,198,900**
Total		\$30,594,735		\$35,238,068		\$46,716,885

¹ Air pollution and carbon values are derived using the latest version of i-Tree Vue 4 and stormwater values are calculated in CITYGreen.

* Stormwater values are calculated based on the cost of building man-made structures to hold peak run off flows.

** Annual stormwater costs are derived by taking the actual cost of the man-made structures financed at 6% interest for 20 years.

Forest Fragmentation

Urban forests provide numerous environmental and socioeconomic benefits, but the benefits to wildlife may not always be fully appreciated. The urban ecosystem is extremely complex and diverse; existing in a multitude of layers formed by small, functional ecosystems that together form a larger system. The overall health of the urban ecosystem depends highly on the ability of the trees, plants, wildlife, insects, and humans to interact collectively as a whole. However, a key factor in declining urban health is urban build-up and sprawl, which can lead to the removal and decrease of canopy across a community. Often this effect causes canopies to be fragmented and leads to the degradation of ecosystem health, which in turn leads to a decline in habitat quality and canopy connectivity. This decline results in changes and imbalance to microclimates and increases the risk and susceptibility to invasive species.

As a part of the UTC assessment, Davey Resource Group analyzed Lexington's existing UTC for fragmentation. This analysis focused on how tree canopy is spatially distributed throughout the Urban Service Area and provided an index displaying the degree of fragmentation (Figure 8). Often, the health and diversity of the overall canopy can be greatly improved by creating linkages between multiple patches of forest. The analysis found that Lexington's urban forest includes the following:

- **113 acres of Core Canopy.** Tree canopy that exists within and relatively far from the forest/non-forest boundary (i.e., forested areas surrounded by more forested areas).
- **131 acres of Perforated Canopy.** Tree canopy that defines the boundary between core forests and relatively small clearings (perforations) within the forest landscape.
- **1,608 acres of Edge Canopy.** Tree canopy that defines the boundary between core forests and large non-forested land cover features. When large enough, edge canopy may appear to be unassociated with core forests.
- **11,606 acres of Patch Canopy.** Tree canopy that comprises a small forested area that is surrounded by non-forested land cover.

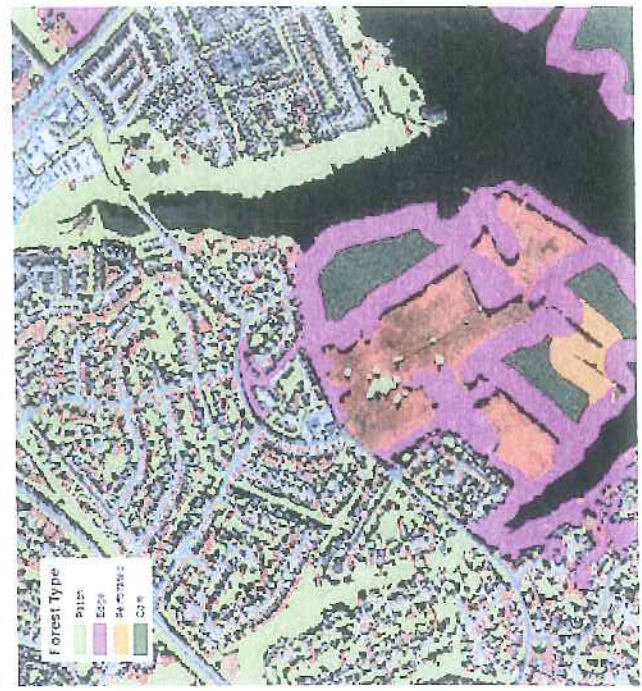


Figure 8. Forest fragmentation identified by canopy structure.

UTC-Based Planting Plan

Delineation between viable and unviable planting areas through the use of UTC data provides a general idea for how much canopy coverage can increase within given boundaries. The assessment of Lexington's Urban Service Area indicates there are possibly 16,253 acres of land that could potentially be planted with trees.

Some planting sites would provide more tree benefits than other sites. For instance, Lexington's UTC analysis included consideration of environmental factors and natural resources to develop a planting priority for sites at greatest risk of soil loss or degradation. An explanation of the eight environmental and social factors used to prioritize future planting sites is provided in Appendix C.

To identify planting areas that will return the greatest and most diverse amount of benefits to LFUCG, Davey Resource Group assessed a number of environmental and social features, including existing canopy and land cover, soil permeability (where available), riparian areas, urban heat island, slope, road density, and population density. Each of these features was used to create individual grids that were assigned a value between 0 and 4. By overlaying these grid maps and adding the values at any given point, a priority planting scale was developed based on the level of need (Figure 9). Planting trees in areas of high and very high need can reduce the risk of soil loss and degradation from storm and flood events as well as reduce urban heat island.

The analysis identified the following acres of preferred planting sites based on risk*:

- Very High – 1,223 acres
- High – 4,833 acres
- Moderate – 5,868 acres
- Low – 3,689 acres
- Very Low – 427 acres

* Planting areas less than 100 square feet were eliminated from this analysis due to irregularly shaped polygons. These locations were omitted because they were found to not have enough suitable planting space. Equals a 240-acre difference in planting area.

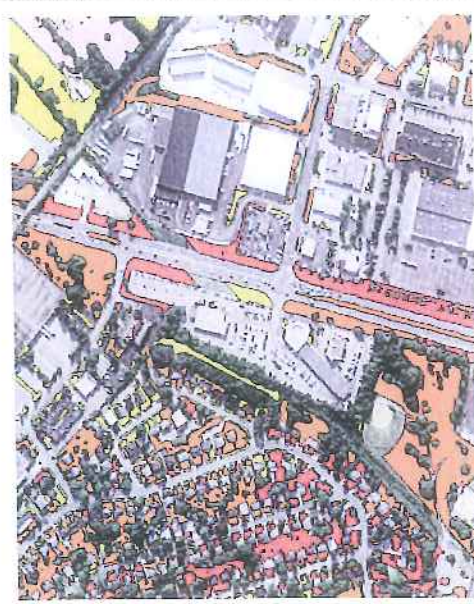
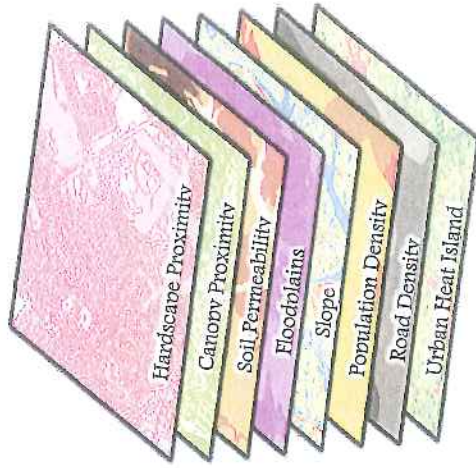


Figure 9. Priority planting site results.

Prioritized Planting Plan

Future planting projects can be discussed and planned by LFUCG with the information contained in prioritized, preferred planting sites isolated by the UTC assessment. Approximate numbers and tree size suggestions are included for each prioritized area with an emphasis on maximizing the population of large canopy tree species. Tree size assignment results are presented in Table 5.

Figure 10 illustrates the GIS data layer and associated attributes of the prioritized planting plan. Tree planting areas can be viewed or used as polygons or as points for planning purposes

depending on the level of detail required. When viewing either polygons or points, the attribute table will indicate whether the species recommended for a given area is a small, medium, or large tree. The attribute table will also include information organized by identified geographical areas. Those areas identified by LFUCG include land use, council district, block group, neighborhood association, priority level, and urban heat island. Additional attributes identified include presence as a street tree, presence in a riparian area, and ownership.

The GIS data layer was provided along with this report on CD ROM.

Table 5. Prioritized Planting Plan
Tree Size Assignments

Tree Size	Count
Large	108,704
Medium	114,438
Small	161,245
Total	384,387*
*Public trees = 62,809	

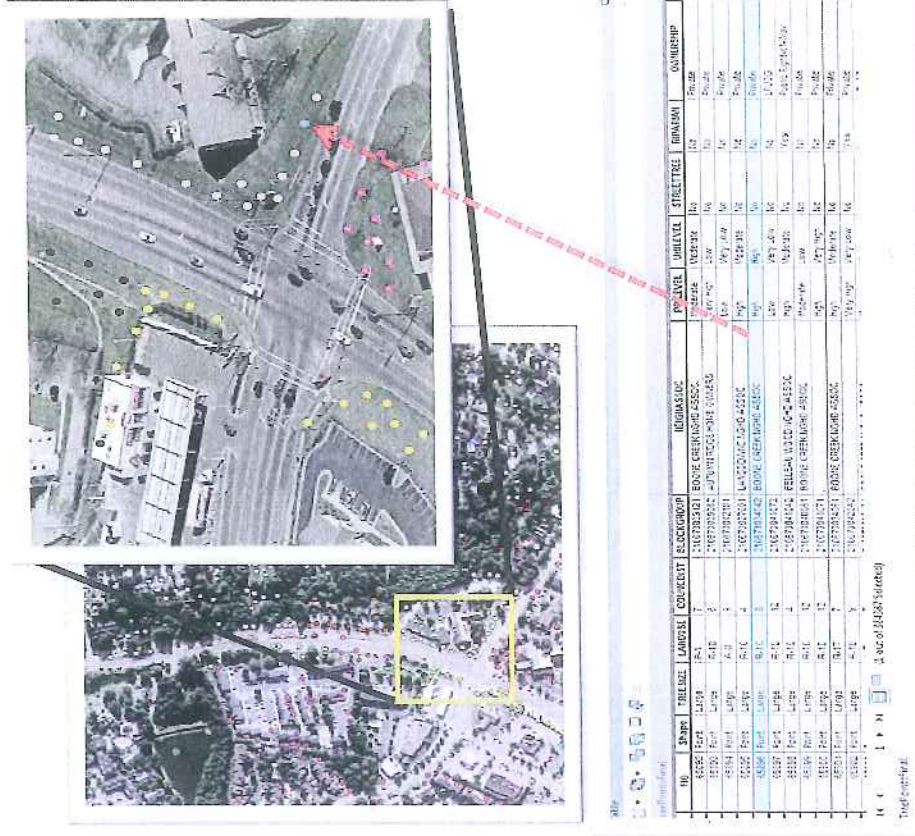


Figure 10. Preferred tree planting sites with their associated attributes.

Tree Canopy Calculator

Acreage within the Lexington Urban Service Area identified as preferred planting areas was analyzed to determine approximate tree counts and costs needed to populate these areas with new trees. The Urban Tree Resource Analysis and Cost Estimator (UTRACE) utilized the UTC data to estimate the trees required and costs to increase and maintain canopy.

UTRACE identifies the existing percentage of canopy cover and allows the user to set the desired canopy cover percentage in order to estimate the number of tree plantings that are biophysically possible to plant within the available planting space. It then estimates budget implications.

The canopy calculator has components which account for the number of trees plantable by crown diameter size—small, medium, or large—based on the total plantable acreage available. The tool also allows for the canopy percentage to be classified by land use categories or other unique boundaries and generates graphical representations of the results of each scenario. The percentage distribution by crown diameter size and further classification by land use categories results in the best plan both biophysically and economically.

Utilizing baseline percentages from the UTC analysis, this tool generated possible planting scenarios to attain the desired canopy goal. This analysis considered the preferred planting area as the target, assumed a mortality rate of 10%, and used a desired tree size distribution of 10% at 15-foot crown diameter, 40% at 30-foot crown diameter, and 50% at 40-foot crown diameter.

Table 6 shows a scenario for estimated costs and trees required to increase canopy by 2% within each watershed by planting in all preferred plantable areas. Table 7 shows a scenario for estimated costs and trees required to increase canopy by 2% within each council district by planting in all preferred plantable areas. UTRACE can be customized and is fully adjustable to allow LFUCG to plan and consider additional planting strategies. Definitions of the UTRACE inputs and results are provided in Appendix D. The UTRACE application was provided along with this report on CD ROM.

Table 6. A Sample Watershed Planting Strategy to Estimate Trees and Costs to Increase Canopy

Watersheds	Possible UTC	Existing UTC Acres	Existing UTC (%)	Preferred Plantable Acres	Total Preferred UTC (%)	Number of Trees Plantable	Change in UTC (%)	Projected UTC (%)	Number of Trees Required at 10% Mortality Rate	Estimated Tree Planting Cost*
Cane Run	3,636.51	1,556.14	20.97	2,414.12	32.53	119,144	2	22.97	8,058	\$3,223,191
Town Branch	1,391.48	519.63	17.74	1,079.72	36.86	53,287	2	19.74	3,180	\$1,272,045
Steeles Run	48.03	34.23	39.60	4.41	5.10	218	2	41.60	94	\$37,533
North Elkhorn Creek	57.73	18.44	22.06	12.10	14.47	597	2	24.06	91	\$36,311
Town Branch	1,523.19	1,382.62	24.77	1,318.62	23.62	65,078	2	26.77	6,061	\$2,424,372
David Creek	196.31	64.09	21.96	79.51	27.25	3,924	2	23.96	317	\$126,732
Wolf Run	2,027.75	1,671.69	27.61	1,744.03	28.81	86,073	2	29.61	6,574	\$2,629,546
North Elkhorn Creek	3,218.23	1,278.62	19.42	1,746.92	26.54	86,216	2	21.42	7,147	\$2,858,840
South Elkhorn Creek	2,371.14	1,800.54	27.29	2,159.37	32.73	106,571	2	29.29	7,163	\$2,865,007
West Hickman Creek	3,861.69	3,374.58	29.38	3,339.03	29.07	164,791	2	31.38	12,470	\$4,988,017
East Hickman Creek	3,521.34	1,703.00	22.83	2,326.98	31.19	114,843	2	24.83	8,100	\$3,240,015
Total	21,853.41	13,403.58		16,224.82		800,742			59,254	\$23,701,609

* Estimated costs were calculated by using monetary values given by the City of Lexington. Tree costs were \$300 for small trees, \$400 for medium trees, and \$500 for large trees.

Table 7. A Sample Council District Planting Strategy to Estimate Trees and Costs to Increase Canopy

Council Districts	Possible UTC	Existing UTC Acres	Existing UTC (%)	Preferred Plantable Acres	Total Preferred UTC (%)	Number of Trees Plantable	Change in UTC (%)	Projected UTC (%)	Number of Trees Required at 10% Mortality Rate	Estimated Tree Planting Cost*
1	1,618.80	952.72	21.61	1,439.67	32.66	71,052	2	23.61	4,716	\$1,914,528
2	3,351.51	1,258.94	17.97	2,233.62	31.88	110,236	2	19.97	7,494	\$3,042,493
3	634.99	636.85	24.41	601.68	23.06	29,695	2	26.41	2,791	\$1,132,963
4	1,091.22	1,083.73	31.92	995.96	29.33	49,153	2	33.92	3,632	\$1,474,700
5	1,321.68	1,409.97	30.34	1,139.65	24.53	56,245	2	32.34	4,971	\$2,018,158
6	2,390.39	1,301.12	22.52	1,614.12	27.94	79,662	2	24.52	6,181	\$2,509,419
7	1,907.94	1,012.97	21.72	1,704.65	36.56	84,129	2	23.72	4,988	\$2,025,044
8	1,014.60	819.10	28.90	920.04	32.46	45,407	2	30.90	3,032	\$1,231,134
9	1,658.58	1,149.86	26.60	1,329.03	30.74	65,592	2	28.60	4,625	\$1,877,757
10	1,539.37	1,159.54	26.37	1,496.73	34.04	73,868	2	28.37	4,704	\$1,909,777
11	1,134.45	1,011.74	29.82	977.29	28.80	48,232	2	31.82	3,630	\$1,473,659
12	4,221.37	1,621.83	22.61	1,799.89	25.09	88,830	2	24.61	7,674	\$3,115,784
Total	21,884.89	13,418.38		16,252.32		802,100			58,438	\$23,725,416

* Estimated costs were calculated by using monetary values given by the City of Lexington. Tree costs were \$300 for small trees, \$400 for medium trees, and \$500 for large trees.

Conclusion

Trees are a unique "technology" because they produce multiple benefits at the same time. The primary reason for planting a tree does not limit the overall benefit it provides. For example, a tree planted to shade a window still provides other benefits, such as removing particulate matter from the air and increasing property values. More information on the benefits of the urban forest is included in Appendix F.

Lexington's existing UTC covers 24.56% of the total land area. During the last 18 years there has been a 5% increase of canopy cover. The UTC of Lexington's Urban Service Area is a vital asset to Fayette County, providing a value of \$30.6 million in environmental and socioeconomic benefits. Air quality improvement accounts for 13%, carbon sequestration and storage account for 38%, and stormwater management accounts for 49% of total benefits.

The maximum potential UTC based on all the possible area available for planting in the Urban Service Area is 55%. Increasing UTC from 25% to 30% will provide an increase in benefits and values by nearly 15%. Increasing UTC from 25% to 40% will provide an increase in benefits and values by nearly 53%.

The management of trees in an urban forest can be challenging. Balancing the recommendations of experts, the needs of residents, the pressures of local economics and politics, the concerns for public safety and liability issues, the physical aspects of trees, the forces of nature and severe weather events, and the desires for all of these factors to be met simultaneously is an overwhelming task. LFUGG must carefully consider each specific issue and balance these pressures with a local knowledgeable and an understanding of trees and their needs. If a balance is achieved, Lexington's unique livability will grow stronger and the health and safety of its trees and residents will be maintained.

As more communities focus attention on environmental sustainability, community forest management has become increasingly dependent on GIS for UTC mapping and analysis. Understanding the importance of existing UTC is a key measure for identifying various types of community forestry management opportunities.

Urban forestry research and applications aid in determining a balance between growth and preservation by identifying and assessing existing forestry opportunities. GIS-based analysis of UTC is a crucial step toward allowing urban planners, foresters, and elected officials to work in the direction of achieving balance between development and conservation.

With the completion of this UTC assessment, LFUGG can now use the data to set goals towards increasing the amount of UTC within Lexington's Urban Service Area. Reaching the maximum potential UTC will be a challenge; however, preserving existing UTC, establishing realistic UTC goals, and harnessing the maximum amount of ecosystem benefits by planting large-growing trees are prudent and responsible endeavors.

Glossary

- bare soil land cover:** The land cover areas mapped as bare soil typically include vacant lots, construction areas, and baseball fields.
- canopy:** Branches and foliage which make up a tree's crown.
- canopy cover:** As seen from above, it is the area of land surface that is covered by tree canopy.
- canopy spread:** A data field that estimates the width of a tree's canopy in five-foot increments.
- existing UTC:** The amount of UTC present within the city boundary.
- geographic information systems (GIS):** A technology that is used to view and analyze data from a geographic perspective. The technology is a piece of an organization's overall information system framework. GIS links location to information (such as people to addresses, buildings to parcels, or streets within a network) and layers that information to give you a better understanding of how it all interrelates.
- greenspace:** A land use planning and conservation term used to describe protected areas of undeveloped landscapes.
- impervious land cover:** The area that does not allow rainfall to infiltrate the soil and typically includes buildings, parking lots, and roads.
- i-Tree Canopy:** The i-Tree Canopy tool allows users to easily photo-interpret Google aerial images of their area to produce statistical estimates of tree and other cover types along with calculations of the uncertainty of their estimates. A simple, quick, and inexpensive means for cities and forest managers to accurately estimate their tree and other cover types.
- i-Tree Tools:** State-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban forestry analysis and benefits assessment tools. The i-Tree Tools help communities of all sizes to strengthen their urban forest management and advocacy efforts by quantifying the structure of community trees and the environmental services that trees provide.
- i-Tree Vue:** The i-Tree Vue tool makes use of freely available National Land Cover Data (NLCD) maps to assess land cover, including tree canopy, and some of the ecosystem services, carbon storage and sequestration, and air quality, provided by the current urban forest. The effects of planting scenarios on future benefits can also be modeled using Vue.
- land cover:** Physical features on the earth mapped from satellite or aerial imagery such as bare soils, canopy, impervious, pervious, or water.
- nitrogen dioxide (NO₂):** Nitrogen dioxide is a compound typically created during the combustion processes and is a major contributor to smog formation and acid deposition.
- open water land cover:** The land cover areas mapped as water typically include lakes, oceans, rivers, and streams.

ozone (O_3): A strong-smelling, pale blue, reactive toxic chemical gas with molecules of three oxygen atoms. It is a product of the photochemical process involving the Sun's energy. Ozone exists in the upper layer of the atmosphere as well as at the Earth's surface. Ozone at the Earth's surface can cause numerous adverse human health effects. It is a major component of smog.

particulate matter (PM_{10}): A major class of air pollutants consisting of tiny solid or liquid particles of soot, dust, smoke, fumes, and mists.

pervious land cover: The vegetative area that allows rainfall to infiltrate the soil and typically includes parks, golf courses, and residential areas.

possible UTC: The amount of land that is theoretically available for the establishment of tree canopy within the city boundary.

riparian: Of or relating to or located on the banks of a river or stream.

right-of-way (ROW): A strip of land generally owned by a public entity over which facilities, such as highways, railroads, or power lines, are built.

street tree: A street tree is defined as a tree within the right-of-way.

species: Fundamental category of taxonomic classification, ranking below a genus or subgenus and consisting of related organisms capable of interbreeding.

sulfur dioxide (SO_2): A strong-smelling, colorless gas that is formed by the combustion of fossil fuels. Sulfur oxides contribute to the problem of acid rain.

tree: A tree is defined as a perennial woody plant that may grow more than 20 feet tall. Characteristically, it has one main stem, although many species may grow as multi-stemmed forms.

tree benefit: An economic, environmental, or social improvement that benefited the community and resulted mainly from the presence of a tree. The benefit received has real or intrinsic value associated with it.

urban forest: All of the trees within a municipality or a community. This can include the trees along streets or rights-of-way, parks and greenspaces, and forests.

urban tree canopy (UTC) assessment: A study performed of land cover classes to gain an understanding of the tree canopy coverage, particularly as it relates to the amount of tree canopy that currently exists and the amount of tree canopy that could exist. Typically performed using aerial photographs, GIS data, or Lidar.

Appendix A

Methodology and Accuracy Assessment

Davey Resource Group Classification Methodology

Davey Resource Group utilized an object-based image analysis (OBIA) semi-automated feature extraction method to process and analyze current high-resolution color infrared (CIR) aerial imagery and remotely-sensed data to identify tree canopy cover and land cover classifications. The use of imagery analysis is cost-effective and provides a highly accurate approach to assessing your community's existing tree canopy coverage. This supports responsible tree management, facilitates community forestry goal-setting, and improves urban resource planning for healthier and more sustainable urban environments.

Advanced image analysis methods were used to classify, or separate, the land cover layers from the overall imagery. The semi-automated extraction process was completed using Feature Analyst, an extension of ArcGIS®. Feature Analyst uses an object-oriented approach to cluster together objects with similar spectral (i.e., color) and spatial/contextual (e.g., texture, size, shape, pattern, and spatial association) characteristics. The land cover results of the extraction process was post-processed and clipped to each project boundary prior to the manual editing process in order to create smaller, manageable, and more efficient file sizes. Secondary source data, high-resolution aerial imagery provided by each UTC city, and custom ArcGIS® tools were used to aid in the final manual editing, quality checking, and quality assurance processes (QA/QC). The manual QA/QC process was implemented to identify, define, and correct any misclassifications or omission errors in the final land cover layer.

Classification Workflow

- 1) Prepare imagery for feature extraction (resampling, rectification, etc.), if needed.
- 2) Gather training set data for all desired land cover classes (canopy, impervious, grass, bare soil, shadows). Water samples are not always needed since hydrologic data are available for most areas. Training data for impervious features were not collected because the City maintained a completed impervious layer.
- 3) Extract canopy layer only; this decreases the amount of shadow removal from large tree canopy shadows. Fill small holes and smooth to remove rigid edges.
- 4) Edit and finalize canopy layer at 1:1250 scale. A point file is created to digitize-in small individual trees that will be missed during the extraction. These points are buffered to represent the tree canopy. This process is done to speed up editing time and improve accuracy by including smaller individual trees.
- 5) Extract remaining land cover classes using the canopy layer as a mask; this keeps canopy shadows that occur within groups of canopy while decreasing the amount of shadow along edges.
- 6) Edit the impervious layer to reflect actual impervious features, such as roads, buildings, parking lots, etc. to update features.

- 7) Using canopy and actual impervious surfaces as a mask; input the bare soils training data and extract them from the imagery. Quickly edit the layer to remove or add any features. Davey Resource Group tries to delete dry vegetation areas that are associated with lawns, grass/meadows, and agricultural fields.
- 8) Assemble any hydrological datasets, if provided. Add or remove any water features to create the hydrology class. Perform a feature extraction if no water feature datasets exist.
- 9) Use geoprocessing tools to clean, repair, and clip all edited land cover layers to remove any self-intersections or topology errors that sometimes occur during editing.
- 10) Input canopy, impervious, bare soil, and hydrology layers into Davey Resource Group's Five-Class Land Cover Model to complete the classification. This model generates the pervious (grass/low-lying vegetation) class by taking all other areas not previously classified and combining them.
- 11) Thoroughly inspect final land cover dataset for any classification errors and correct as needed.
- 12) Perform accuracy assessment. Repeat Step 11, if needed.

Automated Feature Extraction Files

The automated feature extraction (AFE) files allow other users to run the extraction process by replicating the methodology. Since Feature Analyst does not contain all geoprocessing operations that Davey Resource Group utilizes, the AFE only accounts for part of the extraction process. Using Feature Analyst, Davey Resource Group created the training set data, ran the extraction, and then smoothed the features to alleviate the blocky appearance. To complete the actual extraction process, Davey Resource Group uses additional geoprocessing tools within ArcGIS®. From the AFE file results, the following steps are taken to prepare the extracted data for manual editing.

- 1) Davey Resource Group fills all holes in the canopy that are less than 30 square meters. This eliminates small gaps that were created during the extraction process while still allowing for natural canopy gaps.
- 2) Davey Resource Group deletes all features that are less than 9 square meters for canopy (50 square meters for impervious surfaces). This process reduces the amount of small features that could result in incorrect classifications and also helps computer performance.
- 3) The Repair Geometry, Dissolve, and Multipart to Singlepart (in that order) geoprocessing tools are run to complete the extraction process.
- 4) The Multipart to Singlepart shapefile is given to GIS personnel for manual editing to add, remove, or reshape features.

Accuracy Assessment Protocol

Determining the accuracy of spatial data is of high importance to Davey Resource Group and our clients. To achieve to best possible result, Davey Resource Group manually edits and conducts thorough QA/QC checks on all urban tree canopy and land cover layers. A QA/QC process will be completed using ArcGIS® to identify, clean, and correct any misclassification or topology errors in the final land cover dataset. The initial land cover layer extractions will be edited at a 1:1250 quality control scale in the urban areas and at a 1:2500 scale for rural areas utilizing the most current high-resolution aerial imagery to aid in the quality control process.

To test for accuracy, random plot locations are generated throughout the city area of interest and verified to ensure that the data meet the client standards. A 3x3 grouping of pixels will be compared with the most current NAIP high-resolution imagery (reference image) to determine the accuracy of the final land cover layer. Points will be classified as either correct or incorrect and recorded in a

classification matrix. Accuracy will be assessed using four metrics: overall accuracy, kappa, quantity disagreement, and allocation disagreement. These metrics are calculated using a custom Excel® spreadsheet.

Land Cover Accuracy

The following describes Davey Resource Group's accuracy assessment techniques and outlines procedural steps used to conduct the assessment.

1. *Random Point Generation*—Using ArcGIS, 1,000 random assessment points are generated. These points are utilized as “center points” of 3x3 pixel groupings. A box is drawn around the 9-pixel groupings. The 1,000 randomly generated groupings are used for the accuracy assessment. Using a 3x3 grouping of pixels provides more information for the accuracy assessment since adjacent pixels are also looked at. It also increases the number of pixels assessed since 9 pixels are assessed instead of just a single pixel. This method reduces the weight of the center pixel from 1 to 1/9 since the 3x3 grouping is assessed as a whole.
2. *Point Determination*—Each individual pixel of the 3x3 grouping is carefully assessed by the GIS analyst for likeness with the aerial photography. The number of pixels for each land cover type is recorded. The land cover class with the most pixels represented in the pixel grouping is determined to be the correct land cover class, unless visually disputed on high-resolution sub-meter imagery. To record findings, two new fields, CODE and TRUTH, are added to the accuracy assessment point shapefile. CODE is a numeric value (1–5) assigned to each land cover class (Table 1) and TRUTH is the actual land cover class as identified according to the reference image. If CODE and TRUTH are the same for all nine pixels assessed, then the point is

Table 1. Land Cover Classification Code Values

Land Cover Classification	Code Value
Tree Canopy	1
Impervious	2
Pervious	3
Bare Soil	4
Open Water	5

counted as a correct classification. Likewise, if none of the pixels assessed match, then the point is classified as incorrect. If the location has been 100% egregiously misclassified (all nine pixels incorrect), then the results have the same outcome as using just a single pixel. The same is true for a correct classification.

In most cases, distinguishing if a point is correct or incorrect is straightforward. Points will rarely be misclassified by an egregious classification or editing error. Often incorrect points occur where one feature stops and the other begins. Using 9 pixels for the accuracy assessment instead of only 1 pixel allows for better identification of transitional pixels and assignment of varying degrees of correctness. For example, if the center pixel of the 9-pixel box is considered incorrect, the other 8 pixels surrounding it may still be classified correctly. Thus, instead of the accuracy of this location being completely correct or completely incorrect, it can be classified as mostly correct as opposed to being classified completely incorrect.



3. *Classification Matrix*—During the accuracy assessment, if a point is considered incorrect, it is given the correct classification in the TRUTH column. Points are first assessed on the NAIP imagery for their correctness using a “blind” assessment—meaning that the analyst does not know the actual classification (the GIS analyst is strictly going off the NAIP imagery to determine cover class). Any incorrect classifications found during the “blind” assessment are scrutinized further using sub-meter imagery provided by the client to determine if the point was incorrectly classified due to the fuzziness of the NAIP imagery or an actual misclassification. After all random points are assessed and recorded; a classification (or confusion) matrix is created. The classification matrix for this project is presented in Table 2. The table allows for assessment of user’s/producer’s accuracy, overall accuracy, omission/commission errors, kappa statistics, allocation/quantity disagreement, and confidence intervals (Figure 1 and Table 3)

Table 2. Classification Matrix

Land Cover Class	Tree Canopy	Impervious	Pervious	Bare Soil	Open Water	Row Total	Producer's Accuracy	Errors of Omission
Tree Canopy	234	6	12	0	0	252	92.86%	7.14%
Impervious	3	325	12	0	0	340	95.59%	4.41%
Pervious	5	10	371	0	0	386	96.11%	3.89%
Bare Soil	0	1	0	11	0	12	91.67%	8.33%
Open Water	0	0	0	0	10	10	100.00%	0.00%
Column Total	242	342	395	11	10	1,000		
User's Accuracy	96.69%	95.03%	93.92%	100.00%	100.00%		Overall Accuracy	95.10%
Errors of Commission	3.31%	4.97%	6.08%	0.00%	0.00%		Kappa Coefficient	0.9269

4. Following are descriptions of each statistic as well as the results from some of the accuracy assessment tests.

Overall Accuracy – Percentage of correctly classified pixels; for example, the sum of the diagonals divided by the total points $((234+325+371+11+10)/1,000 = 95.10\%)$.

User's Accuracy – Probability that a pixel classified on the map actually represents that category on the ground (correct land cover classifications divided by the column total $[234/242 = 96.69\%]$).

Producer's Accuracy – Probability of a reference pixel being correctly classified (correct land cover classifications divided by the row total $[234/252 = 92.86\%]$).

Kappa Coefficient – A statistical metric used to assess the accuracy of classification data. It has been generally accepted as a better determinant of accuracy partly because it accounts for random chance agreement. A value of 0.80 or greater is regarded as "very good" agreement between the land cover classification and reference image.

Errors of Commission – A pixel reports the presence of a feature (such as trees) that, in reality, is absent (no trees are actually present). This is termed as a false positive. In the matrix below, we can determine that 3.31% of the area classified as canopy is most likely not canopy.

Errors of Omission – A pixel reports the absence of a feature (such as trees) when, in reality, they are actually there. In the matrix below, we can conclude that 7.14% of all canopy classified is actually present in the land cover data.

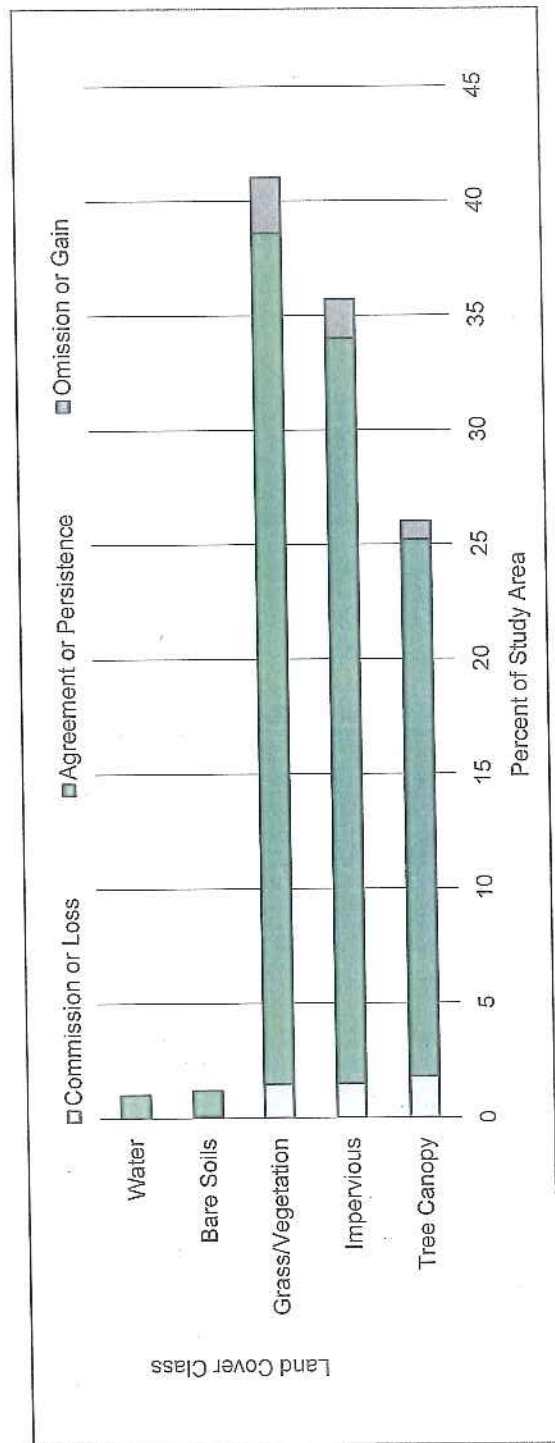


Figure 1. Omission/Commission Errors

Allocation Disagreement – The amount of difference between the reference image and the classified land cover map that is due to less than optimal match in the spatial allocation (or position) of the classes.

Quantity Disagreement – The amount of difference between the reference image and the classified land cover map that is due to less than perfect match in the proportions (or area) of the classes.

Confidence Intervals – A confidence interval is a type of interval estimate of a population parameter and is used to indicate the reliability of an estimate. Confidence intervals consist of a range of values (interval) that act as good estimates of the unknown population parameter based on the observed probability of successes and failures. Since all assessments have innate error, defining a lower and upper bound estimate is essential.

Table 3. 95% Confidence Intervals, Accuracy Assessment, and Statistical Metrics Summary

Land Cover Assessment

Land Cover Class	Acreage	Percentage	Lower Bound	Upper Bound
Tree Canopy	13,420	24.56%	24.4%	24.8%
Impervious	18,763	34.34%	34.0%	34.5%
Pervious	21,470	39.30%	39.1%	39.5%
Bare Soil	416	0.76%	0.7%	0.8%
Open Water	560	1.03%	1.0%	1.1%
Total	54,630	100.00%		

Accuracy Assessment

Land Cover Class	User's Accuracy	Lower Bound	Upper Bound	Producer's Accuracy	Lower Bound	Upper Bound
Tree Canopy	96.7%	95.5%	97.8%	92.9%	91.2%	94.5%
Impervious	95.0%	93.9%	96.2%	95.6%	94.5%	96.7%
Pervious	93.9%	92.7%	95.1%	96.1%	95.1%	97.1%
Bare Soil	100.0%	100.0%	100.0%	91.7%	83.7%	99.6%
Open Water	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

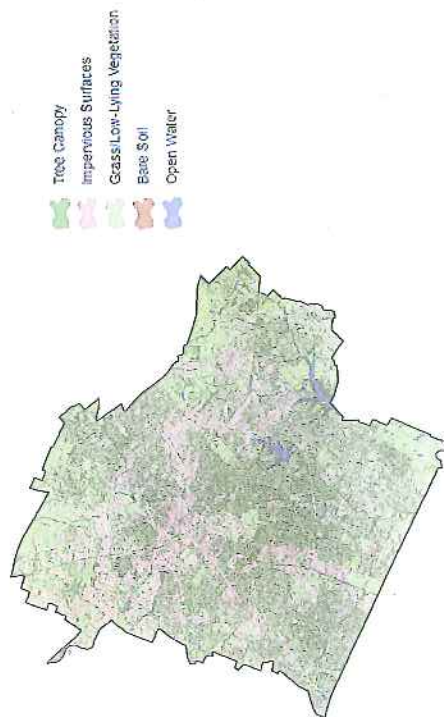
Statistical Metrics Summary

Overall Accuracy =	95.10%
Kappa Coefficient =	0.9269
Allocation Disagreement =	4%
Quantity Disagreement =	1%



Lexington, Kentucky - Urban Tree Canopy Assessment

Five-Class Land Cover Distribution for the Urban Service Area
(referenced 2012 NAIP Imagery)



Tree Canopy Goal Setting

Establishing tree canopy goals is essential for communities that want to create a sustainable urban forest and increase the stormwater, air quality, energy use reduction, quality of life, and other benefits trees provide. Appropriate tree canopy goals should be set for all areas of Lexington; from the entire region down to each neighborhood and business district. Knowing how much urban tree canopy is currently present is the first step in this goal-setting process, followed by determining the desired amount of tree canopy that could practically be established through planting site analysis.

American Forests, a recognized leader in conservation and urban forest management, has established an average canopy goal of 40% for metropolitan areas. The Commonwealth of Kentucky encourages this standard as a general guideline or target for Kentucky communities to achieve.

Lexington's Urban Tree Canopy

Urban trees play an important role in our daily lives; they provide many economic, environmental, and social benefits and significantly improve Lexington's quality of life. Trees reduce the urban heat island effect and help to cool the atmosphere, improve water quality, save energy, reduce stormwater flooding and damage, mitigate air pollution, increase property values, provide wildlife habitat, improve our health, and provide psychological and aesthetic benefits.

The amount of urban tree canopy (UTC) determines how many of these economic, environmental, and social benefits Lexington receives from its trees. UTC is composed of the leaves, stems, and branches of all public and private trees as viewed from above using satellite and aerial images and local geographic information systems (GIS) land cover data. The UTC assessment provides an understanding of the amount and distribution of existing tree cover among other land cover types within Lexington's Urban Service Area.

Lexington's 2012 tree canopy cover is 24.56%. A study completed by the United States Forest Service found Kentucky's statewide tree canopy cover to be at 41.8% and urban area cover to be at 18.6%. A separate study determined that Louisville's metro area had tree canopy cover of 27%. The historical land cover assessment showed Lexington's canopy increased by 5% in the last 18 years. Data analysis shows Lexington's existing UTC provides an estimated \$30,594,735 in benefits and savings to the community.

Lexington's 2012 Land Cover Results for the Urban Service

Land Cover	Acres	Percent Land Cover
Tree Canopy	13,420	24.56%
Impervious—Roads, Buildings, Houses, Parking Lots	18,763	34.34%
Pervious—Grass, Low Vegetation, Agricultural Fields, Wetlands	21,470	39.30%
Bare Soils—Ball Fields, Non-Vegetative Ground, Construction Sites	416	0.76%
Open Water—Lakes, Reservoirs, Ponds, Large Rivers	560	1.03%
Total	54,630	100.00%

For more information contact: Lexington-Fayette Urban County Government

Urban Forester Tim Queary 859-258-3404

Arborist Senior John Saylor 859-258-3405

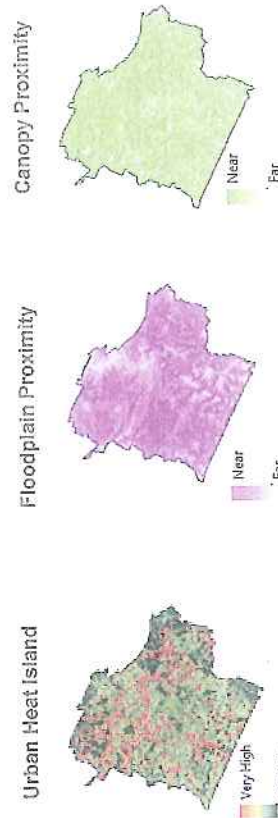
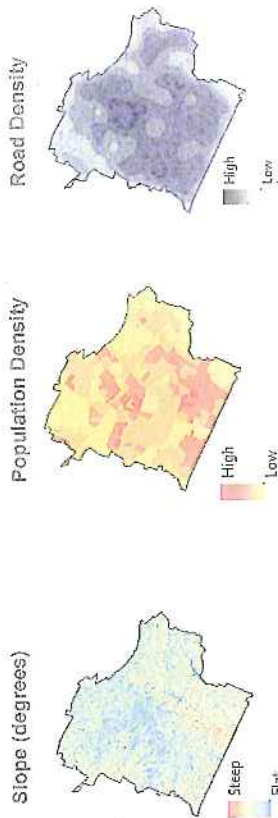




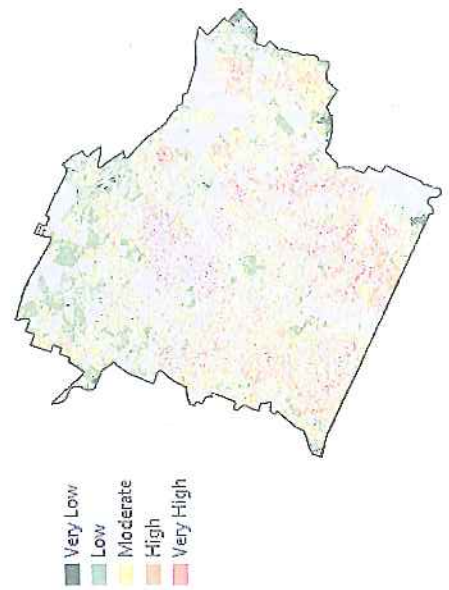
Lexington, Kentucky - UTC-Based Prioritized Planting Plan

Preferred Planting Site Selection

Based on the results of the UTC, a prioritized planting plan was created for Lexington's Urban Service Area. Only areas that could reasonably be considered for planting were included in the plan—cemeteries, golf courses, agricultural land, and sports fields were not included. Preferred planting areas were assessed by analyzing topography, census data, road networks, urban heat island data, floodplain, soil types, and the current land cover data to locate and prioritize new tree planting areas. The high priority locations should be the focus of new tree planting projects as these are areas where trees will provide the most benefits to the community.



Planting Site Priority Level



Lexington's Council District Urban Tree Canopy Assessment

Council District	District Acres	Existing Canopy		Preferred Planting		Maximum UTC	
		Acres	Percent	Acres	Percent	Acres	Percent
1	4,408.25	952.72	21.61	1,439.67	32.66	2,392.39	54.27
2	7,005.42	1,258.94	17.97	2,233.62	31.88	3,492.56	49.86
3	2,608.68	636.85	24.41	601.68	23.06	1,238.54	47.48
4	3,395.53	1,083.73	31.92	995.96	29.33	2,079.69	61.25
5	4,646.86	1,409.97	30.34	1,139.65	24.53	2,549.62	54.87
6	5,778.00	1,301.12	22.52	1,614.12	27.94	2,915.24	50.45
7	4,662.71	1,012.97	21.72	1,704.65	36.56	2,717.61	58.28
8	2,834.72	819.10	28.90	920.04	32.46	1,739.14	61.35
9	4,323.58	1,149.86	26.60	1,329.03	30.74	2,478.89	57.33
10	4,397.31	1,159.54	26.37	1,496.73	34.04	2,656.27	60.41
11	3,393.14	1,011.74	29.82	977.29	28.80	1,989.03	58.62
12	7,174.17	1,621.83	22.61	1,799.89	25.09	3,421.72	47.70
Urban Service Area ^a	54,630	13,420	24.56%	16,253	29.75%	29,673	54.31%

^aRounding may cause values to be slightly different than the Urban Service Area totals.



For more information contact: Lexington-Fayette Urban County Government
Urban Forester Tim Queary 859-258-3404
Arborist Senior John Saylor 859-258-3405

Fund 4002 Sanitary Sewers Operating Fund

Revenue & Expenditures Statement

Year to Date Through Jan 31, 2014

Title	Original Budget	Amended Budget	YTD Through 1/31/2014	Remaining Budget	Percent Collected/Used
Revenues:					
Charges for Services	45,275,900	45,275,900	28,686,195	16,589,705	63.4%
Intergovernmental Revenue	484,200	484,200	512,871	-28,671	105.9%
Investment Income (non-op)	400,000	400,000	517,938	-117,938	129.5%
Other Income	20,000	20,000	23,709	-3,709	118.5%
Transfers In	0	295,448		295,448	0.0%
Total Revenue	46,180,100	46,475,548	29,740,713	16,734,835	64.0%
Expenses:					
Personnel	12,435,040	12,527,697	6,064,925	6,462,772	48.4%
Operating Expenses	25,300,970	25,626,890	10,852,530	14,774,360	42.3%
Capital	6,327,650	6,896,000	630,511	6,265,489	9.1%
Total Expenditures	44,063,660	45,050,587	17,547,966	27,502,621	39.0%
Net Difference	2,116,440	1,424,961	12,192,747		
FY Available Fund Balance	0	0			
	<u>2,116,440</u>	<u>1,424,961</u>			
FUNDS 4002-4004:					
Unrestricted Fund Balance 6.30.13 \$0 M					
Capital Reserves 60.7 M					

Fund 4003 Sanitary Sewers Construction Fund

Revenue & Expenditures Statement

Year to Date Through Jan 31, 2014

Title	Original Budget	Amended Budget	YTD Through 1/31/2014	Remaining Budget	Percent Collected/Used
Revenues:					
Charges for Services			89,413	89,413	0.0%
Investment Income (non-op)			123	123	0.0%
Other Financing Sources	25,000,000	25,000,000	6,349,218	18,650,782	25.4%
Total Revenue	25,000,000	25,000,000	6,438,754	18,740,318	25.8%
Expenses:					
Operating Expenses	3,345,000	11,812,434	1,546,691	10,265,743	13.1%
Transfers		230,703		230,703	0.0%
Capital	40,252,830	83,140,065	14,917,238	68,222,827	17.9%
Total Expenditures	43,597,830	95,183,202	16,463,929	78,719,273	17.3%
Net Difference	-18,597,830	-70,183,202	-10,025,175		
FY Available Fund Balance	0	0			
	<u>-18,597,830</u>	<u>-70,183,202</u>			
FUNDS 4002-4004:					
Capital Reserves	60.7 M				

Fund 4051 Water Quality Operating Fund

Revenue & Expenditures Statement

Year to Date Through Jan 31, 2014

Title	Original Budget	Amended Budget	YTD Through 1/31/2014	Remaining Budget	Percent Collected/Used
Revenues:					
Charges for Services	11,500,000	11,500,000	7,634,008	3,865,992	66.4%
Fines and Forfeitures	14,000	14,000	43,893	-29,893	313.5%
Investment Income (non-op)			-33,440	-33,440	0.0%
Other Financing Sources	2,100,000	2,100,000		2,100,000	0.0%
Other Income	4,800	4,800	1,196	1,196	0.0%
Total Revenue	13,618,800	13,618,800	7,645,657	5,903,855	56.1%
Expenses:					
Personnel	4,414,650	4,337,572	2,231,025	2,106,547	51.4%
Operating Expenses	7,403,980	4,922,200	1,956,264	2,965,936	39.7%
Capital	3,855,400	347,688	50,519	297,169	14.5%
Total Expenditures	15,674,030	9,607,460	4,237,808	5,369,652	44.1%
Net Difference	-2,055,230	4,011,340	3,407,849		
FY Available Fund Balance	0	0			
	-2,055,230	4,011,340			
Unrestricted Fund Balance					
6.30.13	6.1 M				

Fund 4052 Water Quality Construction Fund

Revenue & Expenditures Statement

Year to Date Through Jan 31, 2014

Title	Original Budget	Amended Budget	YTD Through 1/31/2014	Remaining Budget	Percent Collected/Used
Expenses:					
Operating Expenses		6,136,417	661,433	5,474,984	10.8%
Capital		3,655,331	544,947	3,110,384	14.9%
Total Expenditures	0	9,791,748	1,206,380	8,585,368	12.3%
Net Difference	0	-9,791,748	-1,206,380		
FY Available Fund Balance	0	0			
	0	-9,791,748			
Unrestricted Fund Balance					
6.30.13	6.1 M				

Fund 4121 Landfill Operating Fund
Revenue & Expenditures Statement
Year to Date Through Jan 31, 2014

Title	Original Budget	Amended Budget	YTD Through 1/31/2014	Remaining Budget	Percent Collected/Used
Revenues:					
Charges for Services	6,704,530	6,704,530	3,975,083	2,729,447	59.3%
Investment Income (non-op)			1,541	1,541	0.0%
Other Income	222,000	222,000	124,182	97,818	55.9%
Total Revenue	6,926,530	6,926,530	4,100,806	2,828,806	59.2%
Expenses:					
Personnel	748,690	748,690	359,403	389,287	48.0%
Operating Expenses	5,491,580	5,623,210	2,624,227	2,998,983	46.7%
Transfers	200,000	200,000	100,000	100,000	50.0%
Capital	1,040,000	1,678,102	39,837	1,638,265	2.4%
Total Expenditures	7,480,270	8,250,002	3,123,467	5,126,535	37.9%
Net Difference	-553,740	-1,323,472	977,339		
FY Available Fund Balance	0	0			
	-553,740	-1,323,472			
Unrestricted Fund Balance					
6.30.13	14.5 M				

Committee Referrals

Environmental Quality Committee

Item	Referred By	Date	Status
Capacity Analysis	Blues		Part of RMP
Waste Management Funding Options	Stinnett	4-13-11	Waste Management Task Force
Consolidate Greenway Responsibilities	EQ Link	6-19-11	
UK Game Day Solid Waste Collection: Revenue Source	EQ Link	6-19-11	Waste Management Task Force
Bulky Item Collection: Revenue Source	EQ Link	6-19-11	Waste Management Task Force
DWQ Construction Process	Myers	3-17-12	
Empower Lexington Plan	Kay	3-20-12	
Annual Report on Public Education Effectiveness	EQ/PW Link	5-19-12	Oct 2013 Meeting
Distillery District Update	Gorton	11-6-12	March 12, 2013
Waste Management Expenditure Audit	Stinnett	4-23-13	Sept 2013 Meeting Update
Material Recovery Facility Audit Follow Up	Henson	1-28-14	
Tree Canopy Survey	Clarke	1-28-14	

Committee Referrals

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