Surface Water Quality and Ecological Health in Central Appalachian Streams

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Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Biological Systems Engineering

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August 13, 2015
Blacksburg, Virginia

Keywords: surface water quality, inorganic ions, untreated household waste, benthic macroinvertebrates, ecology, sustainability, Appalachia

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ABSTRACT

The Central Appalachian region is home to several resource-extraction industries, a host of globally unique aquatic wildlife species, and region-wide poverty. These overlapping circumstances make solving environmental issues in the region challenging. Of particular focus is the coal mining industry, both because of its prevalence and because of controversial methods of practice such as mountain top mining. One of the primary concerns in the region is the extirpation of sensitive aquatic macroinvertebrate species. Several studies have suggested the primary driver of this loss of biodiversity is due to increased conductivity in streams impacted by these mining practices. The reality is that several pollutant sources coexist in these Central Appalachian watersheds. Because of geographic isolation, many headwater communities lack proper sewerage and discharge directly into nearby waterways, compounding potential effects of upstream mining activities. Additionally, several legacy sites exist throughout the Appalachian region, both underground and surface mining in nature. To best mitigate ecological impacts of all of these pollutant types, relative contributions of each must be understood, as well as the nature of the pollution contributed by each.

As a contribution towards this region-wide need for better information on pollution, the studies comprising this dissertation seek to better understand the composition of these different pollutant sources and their in-stream contributions to conductivity. The first paper found that these sources are indeed distinct in their inorganic ion make-up: surface coal mining was found to contribute primarily Ca, K, Ni, Se, and SO_4^{2-}, while untreated household waste (UHW) was primarily associated with P. HCO_3^- Mn, and Si were found to be associated with a legacy underground discharge. The second and third scientific studies included here analyzed conductivity's effect on Virginia Stream Condition Index (VSCI) versus other water quality and habitat parameters as well as the effect of specific ion suites on VSCI score. Findings indicated that excellent habitat extends species resilience against elevated conductivity, with passing VSCI scores found at conductivity in the 600-800 μs/cm range in cases of excellent habitat metric scores. Meanwhile, VSCI score suppression was highly related to surface mining-related inorganic ions (Ca, K, Mg, Ni, and SO_4^{2-}), but also negatively correlated with ions related to UHW (P and Na). These results indicate the need for quantification of biological responses to specific ions in order to initiate targeted mitigate of pollutants in Central Appalachian watersheds.

ACKNOWLEDGMENTS

I would like to express deep, heartfelt thanks to my co-advisors Dr. Leigh-Anne Krometis and Dr. Emily Sarver for giving me the opportunity to come back and acquire my PhD, for their personal support, and their sense of humor. Coming to Virginia Tech has changed my life for the better and the thread of this story begins with them. Special thanks to the ARIES project and Dr. Mike Karmis and Dr. John Craynon for providing funding that made my project possible. Thanks to my other committee members Dr. Cully Hession, Dr. Nino Ripepi, and especially Gene Yagow, who provided me expertise and reference material on benthic macroinvertebrates and their environment. Thanks to Jeff Parks for his assistance and patience in teaching me to operate the ICP-MS. Special thanks to our environmental consultants Tim Compton and Travis Lowe, who provided our biological sampling but went beyond the call of duty to provide expertise and assistance in the field and in interpreting data.

I would also like to thank all of the sampling buddies that came on the two-day excursion to Wise and Harlan Counties over the two years of sampling. Special mention goes to Dr. Rory Coffey and Tyler Faulkner, who each came on the sampling trip multiple times. Other assistants were Chris Gilson, Tammy Smith, Jordan Wetzig, Jake Cantor, Heather Govenor, Nick Geroux, Julia Sherry, Matt Razaire, Rachel Sellaro, and Leigh-Anne Krometis. Extraordinary thanks are required for Vicki Nystrom and Sara Gokturk for spending countless nights in the lab analyzing samples for bacteria, acid washing bottles, and acidifying samples. They are the glue that made this campaign possible.

Lastly, I want to thank my friends and family for their support. Special recognition goes out to my new, amazing, beautiful, brilliant wife, Danielle Cook, whose awesomeness provided me with the extra motivation to complete this degree and be indescribably happy while doing so.

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AUTHOR'S PREFACE

This dissertation represents a compilation of five separate manuscripts (Chapters 2 through 6) proceeded by an introductory chapter and followed by a chapter that identifies primary conclusions and provides recommendations for further research. The dissertation author is the primary author for the conference proceedings publication and the four articles.

Chapter 2 provides an inventory of bacterial impairments in the central Appalachian region. By comparing land use, population density, impairment type, and mining permit coverage, a GIS analysis showed that bacterial impairments in central Appalachia occur primarily in low-population, forested watersheds within 25 km of mining operations. The nature of the surrounding conditions suggest that the sources for these bacterial impairments are most likely wildlife, domestic animals, or untreated household waste (UHW). Chapter 2 was peer-reviewed and published in the Proceedings of the Environmental Considerations for Energy Production Symposium, which was held in Charleston, WV April 14-18, 2013 (Cook, N. A., Krometis, L. A., & Sarver, E. A. (2013). Inventory of Bacterial Impairments in Central Appalachia. In J. R. Craynon (Ed.), *Environmental Considerations in Energy Production* (pp. 214-228). Englewood, CO: Society for Mining, Metallurgy, and Exploration).

Supported by the general finding from Chapter 2 that bacterial impairments may co-exist with other primary impairments in the central Appalachian region, a two year field study was initiated to investigate the effects of specific pollutant sources on water quality and ecological health in headwater streams. Chapters 3-5 are related to analysis of data collected as part of the field study.

Chapter 3 provides analysis of ion concentration data collected from August 2012 to August 2014 during an intensive clustered watershed monitoring campaign. Using multivariate statistical methods, we demonstrated that different pollutant sources (UHW, surface coal mining, legacy underground mine discharges) could be identified by distinct trends in constituent ions. Specific relationships link phosphorus (P) to UHW, SO_4^{2-} to surface coal mining, and Mn to legacy underground mine discharges. Chapter 3 was peer-reviewed and accepted in *Ecological Engineering* (Cook, N. A., Krometis, L. H., Sarver, E. A., & Huang, J. (2015). Inorganic constituents of conductivity in five central Appalachian watersheds with mixed source-driven pollutants. *Ecological Engineering*, 82, 175-183. doi: http://dx.doi.org/10.1016/j.ecoleng.2015.04.090).

Chapter 4 provides analysis of the seasonal biological monitoring data collected in the study watershed cluster between August 2011 and May 2014. This study compared Virginia Stream Condition Index (VSCI) scores across sites. Higher VSCI scores were correlated with low channel alteration, high vegetation of the riparian and bank zones, and diverse epifaunal substrate, while lower VSCI scores were associated with surface disturbance and elevated conductivity. Results suggest that both habitat and water quality are important for ecological health, and support a holistic approach to ecological improvement. Chapter 4 was revised in accordance with an initial round of largely positive peer reviews and has been resubmitted to *Ecological Engineering*.

Chapter 5 presents an effort to link inorganic ion concentration data collected in the field (Chapter 3) to model concentrations at biological monitoring (Chapter 4) through geo-statistical models. Analysis of VSCI scores and inorganic ions showed negative correlations with ions related to surface coal mining (Ca, K, Mg, Ni, SO_4^{2-}), as well as UHW (most specifically, P and Na). Chapter 5 will be submitted to *Ecological Engineering* in August 2015.

Finally, Chapter 6 presents a review and discussion residential wastewater challenges in the central Appalachian region within the current economic circumstances and regulatory framework, and considering the ultimate aims of corporate social responsibility (CSR) efforts that are underway across many industry sectors. This paper suggests that local industry, along with other key stakeholders, might play a role in solving regional infrastructure challenges, specifically UHW; but that strengthened communication and cooperation amongst all stakeholders will be instrumental in prioritizing regional goals and allocation of resources. Chapter 6 was peer-reviewed and published in *Resources* (April 2015).

CHAPTER 1. INTRODUCTION

The central Appalachian region is comprised of the mountainous regions of eastern Kentucky, southwestern Virginia, and southern West Virginia (ARC, 2011a). The economy of the region is dominated by resource-extraction activities that include coal mining, logging, and natural gas; however, despite these resources, regional poverty is pervasive (ARC, 2011b). Simultaneously, the central Appalachian region is also an area of high species biodiversity both nationally and globally (Olson et al., 1998; Bernhardt et al., 2011). These simultaneous circumstances create a complex backdrop for often hot debates surrounding the balance of ecological, economic, social and cultural goals.

The practice of mountain top mining, which involves deconstructing mountains to access coal seams that would be economically inaccessible by other means, has been at the center of much debate recently. The environmental impacts this mining approach are regulated by multiple federal agencies, and their state-level counterparts, including the Office of Surface Mining and Reclamation Enforcement (OSMRE), the United States Environmental Protection Agency (USEPA), and the Army Corps of Engineers (ACOE). OSMRE regulates mining and reclamation activities under the Surface Mining Control and Reclamation Act (SMCRA), which includes measures to protect the hydrologic balance in mined watersheds. Under SMCRA, land generally must also be returned to its approximate original contour. The ACOE is tasked with satisfying Section 404 of the Clean Water Act (CWA), which pertains to placement of “fill” material into waterways or wetlands. In the case of mountaintop mining, some overburden material is placed in valleys adjacent to the mined mountains, and thus can bury streams or wetlands. Under Section 404, ACOE is responsible for reviewing and approving permits to place fill material, and also projects aimed at replacing or repairing impacted waterways or wetlands. The USEPA is concerned with several aspects of surface coal mining including discharges from sediment ponds and other point sources (National Pollutant Discharge Elimination System, NPDES) and also potential impairment of streams and rivers down gradient from mining permit areas under Section 303 of the Clean Water Act.

A particular focus of this last element of the USEPA’s responsibilities has led to the analysis of biological impairments in streams in Central Appalachia and increased focus on in-stream conductivity. Conductivity is the ability of water to conduct electricity at 25 ^{o}C and is often elevated downstream of any earth-disturbing activities as in-stream densities of sediment and inorganic ions increase with soil runoff. In the central Appalachian region, surface coal mining practices contribute ionic pollution due to increased rock weathering in addition to general sediment loads. Currently, some trace metals are regulated through surface water quality regulations (such as Se, Pb, or Mn), but no regulation currently exists for general conductivity. As a result of the suspected link between biological diversity loss and conductivity, the USEPA developed a field-based benchmark for conductivity in 2010 from data in West Virginia suggesting that conductivity levels above 300 μs/cm would lead to unacceptable aquatic macroinvertebrate species loss (USEPA, 2011). The primary driver for these efforts stems from the USEPA's focus on Section 303 of the Clean Water Act (CWA) and attempts to meet stream designations that support aquatic life.

To this end, the motive of these types of guidelines is to protect aquatic systems, in particular benthic macroinvertebrate assemblages. A primary difficulty with this approach is a wide range of evidence suggesting varying limits of conductivity in both lab (A. J. Kennedy et al., 2004; A.J. Kennedy et al., 2005; Echols et al., 2010) and field studies (Nislow et al., 2006; Freund et al., 2007; Merricks et al., 2007; Pond et al., 2008; Merovich Jr. et al., 2010; Petty et al., 2010; Timpano, 2011; Cormier, Suter, Zheng, et al., 2013; Merriam et al., 2013; Yeager-Armstead et al., 2013). Additionally, were this benchmark to become a regulation, it would likely have far-reaching implications. Several whole-effluent toxicity testing (WETT) studies have shown some conductivity limits as high as 1000 μs/cm for regular test organisms (A.J. Kennedy et al., 2005; J. Elphick et al., 2011; J. R. F. Elphick et al., 2011), with lower limits for more sensitive mayfly species (A. J. Kennedy et al., 2004; Echols et al., 2010). These studies suggest that limits set using standard test organisms are not likely to sufficiently protect sensitive headwater species of benthic macroinvertebrates in the Central Appalachian region. Meanwhile, numerous field studies in the region have suggested increased sensitivity to conductivity as compared to lab studies (Timpano, 2011; Cormier, Suter, & Zheng, 2013; Cormier, Suter, Zheng, et al., 2013). These suggest that factors in the field such as habitat loss or hydrological instability may reduce resilience to impacted water quality. Ultimately, it appears that other environmental factors may separate field and lab observations, despite some explanation of confounding factors by a recent study (Suter et al., 2013). This variability in response is likely the result of different water chemistry conditions (acid mine drainage versus alkaline mine drainage), local in-stream conditions (excellent habitat versus degraded habitat), or even the specific inorganic ion composition of the in-stream conductivity driving benthic macroinvertebrate species loss.

While several studies have characterized the ionic contribution of different variations of coal mining and related practices (Merovich et al., 2007; Cravotta III, 2008; Miguel-Chinchilla et al., 2014; Sena et al., 2014), few studies have included other prevalent pollution sources in the region which may contribute additional sources of ecological stress. In particular, because of the geographical isolation of many small communities in the region, municipal wastewater services are often unavailable (Gasteyer et al., 2004), and the thin soil layer over bedrock typical of Appalachian headwaters renders traditional septic systems impractical. An undocumented number, but likely not insignificant, number of homes consequently directly discharge untreated household waste (UHW) via "straight pipes" into nearby streams. While some studies examine treated wastewater effects on ecology in Central Appalachia(Goudreau et al., 1993), no studies exist analyzing the contribution of this type of pollution to water quality in Central Appalachia although one was found in the Philippines (Dyer et al., 2003). This paper suggests the primary issues with UHW are unionized ammonia as well as low dissolved oxygen (DO), bacterial contamination, and general organic pollution. Benthic macroinvertebrate loss was observed below sewage outlets in this study. This suggests similar impacts may be found in Central

Appalachia; in a region where conductivity is a focus, the contribution of UHW to conductivity may be crucial knowledge. UHW may contribute phosphate and sulfate compounds from household waste in addition to the observed effects in the aforementioned study, which could elevate conductivity.

Because of the complications of field conditions, varying organism sensitivities, pollutant sources, and ionic composition of conductivity in these studies, a causal link between biological diversity loss and conductivity is not easily examined. The reality is that while elevated conductivity and biological diversity loss are negatively correlated, the specific pollutants causing the extirpation, and/or concentrations at which the species loss is deemed unacceptably high, are not well understood. For instance, UHW is not likely to contribute the same ions as acid mine drainage, but both may result in elevated conductivity. Biological sensitivities to these different ion suites are likely to vary, and must be quantified. This dissertation begins to address some of these issues involving UHW prevalence, the characterization of ionic pollution, and biological effects of pollutant-specific ionic suites by addressing the following research questions:

- Q1: Are sources of bacterial surface impairments in states comprising Central Appalachia likely different in Central Appalachia versus those areas outside Central Appalachia?
- Q2: Are bacterial surface impairments related to specific land uses or population distributions in Central Appalachia?
- Q3: Can pollutant sources (UHW, surface coal mining, legacy underground mining) be characterized by ionic suites detected downstream of discharges?
- Q4: Does Virginia Stream Condition Index (VSCI) scores vary with other environmental variables aside from conductivity?
- Q5: What is the relationship between detected ionic suites and VSCI scores?
- Q6: What might a corporate social responsibility framework to solve UHW issues in Central Appalachia look like?

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CHAPTER 2. INVENTORY OF BACTERIAL IMPAIRMENTS IN CENTRAL APPALACHIA

Cook, N.A., Krometis, L.A., Sarver, E.A.

Submitted: November 2012
To: Environmental Considerations in Energy Production
Status: Published in Conference Proceedings, April 2013

Abstract

Although it has been over four decades since water-related regulations such as the CWA, SDWA, and NEPA were passed, significant water quality issues in the United States remain unresolved. In the eastern US in particular, unacceptably high concentrations of pathogen indicator organisms (e.g., Escherichia coli, fecal coliforms) are the primary contaminant responsible for state-identified surface water impairments requiring Total Maximum Daily Load (TMDL) development. Anecdotal reports suggest that inadequate or non-existent wastewater treatment may represent a significant contributor to surface water contamination in remote or underserved regions of Appalachia. In some areas where residences are relatively close to creeks or streams, is not uncommon for household sewage to be discharged directly to receiving waters, a practice known as "straight-piping."

Despite the widespread incidence of fecal indicator bacteria (FIB) impairments, a broad assessment of the extent of identified impairments and their relationship with land use, co-contaminants, and proximity to high-density populations has not been completed for Appalachia. As a preliminary review of these potential relationships, publicly available GIS data were compiled and analyzed for an area of interest that includes six geographically central states in the region, which also share coal production as a current and historical common economic driver. These data were analyzed for the purpose of extracting potential correlations between water quality designations and topographic or demographic factors, and for initiating dialogue on potential solutions that involve a variety of regional stakeholders. Given the relative significance of coal production in the area of interest, specific discussion is offered on the possible requirements and benefits that might be associated with strategies that involve coal industry members as key stakeholders.

Introduction

Although water-related regulations such as the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA), and the National Environmental Policy Act (NEPA) have been in place for over four decades, significant water quality issues in the United States remain unresolved. In accordance with the federal Clean Water Act (CWA) of 1972, states are required to monitor all surface waters within their borders and report any failures to adhere to water quality standards appropriate to their given uses (e.g. fishing, swimming, etc.). Section 305(b) of the law requires that waters be classified by their state-designated use(s). This classification includes a set of accompanying numerical limits for various pollutants (e.g. bacteria) of potential concern published by the US Environmental Protection Agency (USEPA). States must monitor their waters and report those that fail to meet standards associated with specified designated uses pursuant to Section 303(d) of the CWA, hence the list of these impaired waters nationally is frequently referred to as the “303(d) list.” States are required to address waters on this list through the development of Total Maximum Daily Load (TMDL) plans, which identify minimum source-specific pollutant loading reductions required to achieve the designated use for each 303(d)-listed water body. States maintain the right to determine their own schedules of monitoring, methods of data collection, decisions on water body classification, and alternative standards (which may or may not be more stringent than federal standards) based on local land uses, stream designations, or regional hydrology characteristics (e.g. use attainability analyses). If any of these efforts are deemed unsatisfactory, states can be subject to penalty under federal law. This non-centralized decision-making paradigm means that a river that might be listed as impaired in one state may not be so listed in another. It can also lead to discrepancies when comparing data from multiple states. In an effort to eradicate data inconsistencies, the USEPA often issues guidance on best practices for TMDL development for specific pollutants; however, evolving priorities and technology can render goals a shifting target (Keller & Cavallaro, 2008; NRC, 2001).

In the eastern United States, unacceptably high concentrations of pathogen indicator organisms (e.g., Escherichia coli, fecal coliforms) are the primary contaminant responsible for state-identified surface water impairments requiring TMDL development (Gaffield, Goo, Richards, & Jackson, 2003; NRC, 2001; USEPA, 2011). Although generally non-pathogenic themselves, the presence of indicator organisms is associated with contamination by mammalian fecal material and public health risk (Paruch & Mæhlum, 2012). Exposure to waters containing high concentrations of coliform or enterococci bacteria have been linked with an elevated risk of gastroenteritis, respiratory infections, and skin infections in exposed human populations (Prüss, 1998). Common sources of pathogen loadings to receiving waters include inadequately treated wastewater discharges, septic leakage, wildlife, domestic animals, and runoff from manure-amended agricultural soils (Gerba & Smith, 2005; Ishii & Sadowsky, 2008). The degree of contamination by any given source is often related to overall watershed land use and topography (Field & Samadpour, 2007; Mallin, Williams, Esham, & Lowe, 2000).

Development of TMDLs generally follows a four step process: impairment identification; determination of the maximum pollutant load the water body can assimilate while maintaining minimum standards for its designated uses; establishment of links between pollutant sources and receiving water concentrations; and source load allocation to inform implementation plan development. A 2008 survey of TMDLs across the United States determined the leading challenges of TMDL development to be a lack of funding and lack of monitoring data to inform watershed characterization and predictive modeling. Successful implementation of existing TMDLs on private lands generally hinged on the engagement of local stakeholders and the availability of funds (Benham, 2008).

The Appalachian region comprises a wide variety of land uses associated with various potential sources of fecal loadings to surface waters, including: agricultural (livestock sources), forest (wildlife sources), and human communities (wastewater sources). As loadings of human waste are generally considered most likely to contain human-infectious pathogens and therefore of greatest health risk (Ishii & Sadowsky, 2008; Soller, Schoen, Bartrand, Ravenscroft, & Ashbolt, 2010), reports of inadequate sanitation and discharges of untreated sewage in this region are of particular concern (Gasteyer & Vaswani, 2004; Wescoat, Headington, & Theobald, 2007). Many communities in the geographically central part of this region have evolved from coal camps in narrow mountain hollows along streams. Soils along these hollows are notoriously thin, and often inappropriate for septic systems, and housing density often makes appropriate siting of drain fields difficult. Even properly installed septic systems can contribute human waste due to the karst (cracked rock) geology of the region. Groundwater flows quickly through this geological strata, preventing the intended treatment by the system's drain field (Johnson et al., 2011; Katz et al., 2010). Some areas in the region simply discharge the grey water from their septic systems into trenches that run to the streams. In many cases, no septic system exists at all, and waste from household toilets, showers, and other plumbed fixtures is piped directly to the creek or into similar trenches ("straight-piping").

While historical precedent (i.e. the justification that "it's always been this way") or a failure to recognize potential consequences (i.e. lack of education) may contribute to the prevalence of straight-piping, inadequate water and sanitation issues in the United States are often strongly related to economic and/or political challenges (Gasteyer & Vaswani, 2004; Wescoat et al., 2007). According to the latest economic report published by the Appalachian Regional Commission (ARC; www.arc.gov) , this region significantly lags the national average in employment, personal income per capita, investment income, and proprietor average income; and much of the central, coal-producing region lags even further behind (ARC, 2011). Moreover, many of the rural counties in this area are comprised of isolated communities without a sufficiently large central municipality to organize widespread infrastructure efforts. Under such conditions, it is not surprising that centralized or advanced wastewater treatment systems are often absent or implausible. Collaboration between public and private regional stakeholders is likely necessary to improve sanitation and prevent related health risks.

The concept of a collaborative effort requires that parties affected by such decisions be identified. In Appalachia these might include municipal and county governments, taxpayers and citizens, private industries, and groups within the general citizenry that advocate for abstract entities such as the environment or a specific political party. There are also a large number of NGOs (non-government organizations) that seek to influence the region through advocacy for their own specific interests as well. The relationships within and between these groups are often complex, making solutions to any problem in the region non-trivial. Oftentimes, ideological conflicts between opposing groups can overshadow concrete problems that can be more easily addressed with existing technology, such as sewerage issues in rural communities.

Much of the current environmental focus with respect to water quality in the central Appalachian region is on the abundance and diversity of stream macro-invertebrates, which are often used as a proxy for the general degradation of stream ecology (Echols, Currie, & Cherry, 2009; Pond, Passmore, Borsuk, Reynolds, & Rose, 2008). Relatively little attention, however, has been paid to pathogen indicator concentrations in surface waters and related human health risks. The present study describes an initial review of publically available GIS data related to surface water impairments, population density, and common land uses, including coal mining. The goal of this analysis is to examine the relationships between FIB impairments and other factors at the inventory scale in order to prioritize future more finely targeted analyses. To complete this initial inventory-level analysis, data were collected from the various state and federal agencies and projected onto a common GIS coordinate system for comparative analysis using the varied geo-processing abilities of ArcGIS software.

Methods

Appalachia broadly refers to a cultural region in the eastern US, which the ARC has geographically defined to include a total of 420 counties in 13 states spanning from New York in the north to Alabama and Mississippi in the south. For the purposes of this study, the area of interest (AOI) was limited to the ARC counties within six geographically central states: Kentucky, Maryland, Ohio, Pennsylvania, Virginia, and West Virginia (Figure 2-1). This AOI is termed "Central Appalachia" here. This region accounts for the majority of the energy resource production (i.e., coal and natural gas) in Appalachia; Alabama and Mississippi do produce significant coal and gas, respectively, however they are non-contiguous with the AOI and do not share many of the same regional geographic and cultural characteristics.

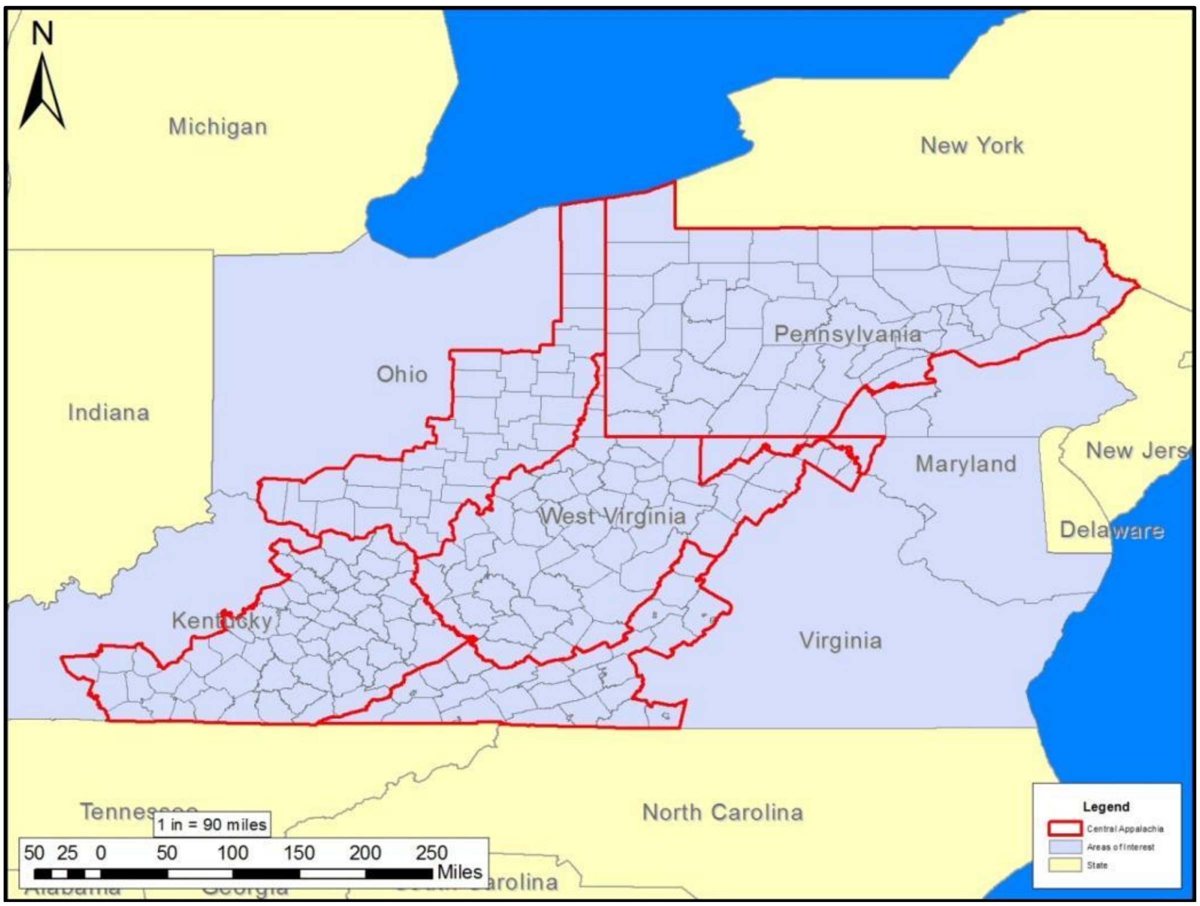

Figure 2-1. Central Appalachian Area of Interest (AOI)

The following datasets were sought for the six states in the Central Appalachian study region as defined above:

- Census tract information
- Government unit boundaries (state and county boundaries)
- Hydrology data (stream and watershed shapefiles)
- Land use characteristics

- Surface coal mining activity (AMLs, active mining, permitted areas)
- Stream impairment information (303(b) and/or 303(d) shapefiles)

The two main goals governing data selection were to examine any potential relationships between stream impairments and other activities at the watershed level, as well as to examine the proximity of coal mining operations to such impairments as a methodology for quantifying the potential significance of targeted mitigation efforts by mine operators. Stream impairments in the form of 303(d) shapefiles represent the best publicly available dataset that describe the conditions of waters within the AOI, the states that comprise Central Appalachia, as well as the country as a whole. The information within the shapefiles are collected by state agencies as a part of their 305(b) and 303(d) responsibilities mandated by the CWA and reviewed by the USEPA. Because these data are formally accepted by both state and federal governments as a descriptor of surface water quality for regulatory purposes, they provide the most practical avenue towards making comparative assessments between watershed characteristics and impairments of interest (in this case, pathogen indicators).

The census tract information was acquired through the US Census TIGERlines database (United States Census Bureau, 2010), which provides borders of government entities such as counties, municipalities, and census districts (including census results). General hydrology data were secured via the National Hydrology Dataset (NHD), however 303(d) data that were used for most analyses were collected directly from the relevant state agencies; this data often includes more updated hydrography than general NHD data (USGS, 2011). Land use characteristics were acquired as a raster (set of 30m x 30m pixels) from the NLCD (National Land Cover Database), which was initially completed in 2006 and is based on imagery collected in the early 2000s (Frye, 2011). Much of the remaining data collection required personal contact with relevant state agencies (e.g. Departments of Environmental Quality) to secure the most up-to-date information. While impairment information is submitted to the USEPA database regularly in keeping with the requirements of the CWA, states often have more recent assessments available locally.

For many states, boundaries of current or permitted coal mining areas were not readily available via generic internet searches. Mining information was alternatively obtained from either the state environmental agency or the state land management agency. For Pennsylvania, all data could be obtained via the Pennsylvania Spatial Data Access (PASDA), which is maintained by Penn State University, the Pennsylvania Office for Information Technology, the Geospatial Technologies Office, and collaborators. This website contains a FTP link through which any state-released GIS data can be downloaded. In states like Virginia, data were split between agencies such as Virginia's Department of Environmental Quality (DEQ) and the Division of Mines, Minerals and Energy (DMME). Data for mining layers could be obtained through interactive mapping programs such as DMME's Geoexplorer map or DEQ's Virginia Environmental Geographical Information Systems (VEGIS). In West Virginia, some data were acquired via the Department of Environmental Protection (DEP), while the mining information was acquired from the West Virginia GIS Technical Center (uploaded by the West Virginia Natural Resource Analysis Center from digitized data produced by DEP's Mining and Reclamation division). Data for other states were more difficult to find; in Kentucky, several searches were required to narrow down a web location for GIS data. Eventually the search led to the Kentucky Geological Survey (KGS) at the University of Kentucky, where links to mining GIS data and hydrology data (303d layers) could be found. Some states, such as Maryland and Ohio, presented greater challenges. Access to Ohio's data required direct electronic communication with specific state agencies, and it was necessary to interpret the data further upon receipt, which meant further person-to-person communication. Ohio data were separated into A, B, C, and D-Law categories based on their status as AMLs or as active mining sites. The data were found through the Ohio's Geographic Information Management Systems (GIMS), which did not allow data download, but provided electronic mail contacts for data requests. Maryland mining data were never recovered, despite multiple attempts to communicate with the relevant state agency. These missing data likely have a minimal impact on the GIS analysis as only three counties in the state of Maryland fall within the Central Appalachian region, and the state is responsible for little coal production.

With respect to surface water impairment data, most states had data readily available via online access at their respective environmental agencies. As mentioned previously, Kentucky, Virginia, Pennsylvania, and West Virginia had readily available 303(d) GIS datasets for download. Two states (Maryland and Ohio) required direct contact to receive information, and the impairment information was only available at watershed resolution (as opposed to stream-segment level resolution). Maryland has scheduled the release of stream-segment level data for late 2012 (after the time of writing), but Ohio has no currently set timetable for improved data. In Pennsylvania, data were downloaded via PASDA, but the actual data were missing fields that were described in the metadata. This omission required contact with the appropriate contacts to resolve, whereupon the corrected data were downloaded via an FTP link.

Once all of the datasets were secured, the challenges associated with combining data from individual states with their own impairment terminology and categorization schemes became increasingly apparent. In the case of Kentucky, numerical rather than textual codes are reported for specific impairment classifications, so further communication with state employees was required to decipher the codes. Ohio and Kentucky have over seventy categories of impairments, while both Maryland and West Virginia have less than fifteen. Many states listed multiple impairments for a single stream (e.g. pathogen indicators and turbidity, etc.) while some states only listed one. Even the category of "FIB impairments" varied greatly between the six states, and the application of different indicator standards (fecal coliform standard versus *E. coli* standard) may result in differences in classification. Table 2-1 shows the different terms by state. The difference in resolution of the data as well as the difference in attribute naming required some intensive parsing to compare accurately. Data for which impairment entries were left blank or labeled "Insufficient Data" were regarded as non-assessed for the purposes of this study.

Table 2-1. Terms for FIB-Impaired Waters by State

State	Terms Indicating FIB impairment
Kentucky	Fecal Coliform, Escherichia Coli
Maryland	Bacteria
Ohio	*E. coli*
Pennsylvania	Pathogens

Virginia	Escherichia Coli, Fecal Coliform
West Virginia	Fecal/Bacteria

GIS Methodology
Following data collection and inventory, the following analyses were completed:

- Comparison of total impairments for the Central Appalachian and non-Central Appalachian sections of each state;
- Quantification of FIB impairments in Central Appalachia vs. non-Central Appalachia (in terms of number of watersheds or stream miles, as appropriate);
- Categorization of FIB-impaired watersheds by dominant land use;
- Comparison of population density in FIB-impaired watersheds; and
- Identification of mining operation proximity to FIB-impaired stream segments or watersheds.

Before performing any analysis on this collection of GIS information, a common projection was required; most of the AOI (Central Appalachia) falls within the NAD 1983 UTM Zone 17, therefore all data was projected to match this zone (most data was initially projected in local state plane formats). Additionally, for all processes requiring clipping, selecting, or intersecting commands, geometry was re-calculated before summaries were completed. For most of these analyses, a simple command in ArcGIS software extracts the necessary information. To find the total impairments, the “select by location” command allowed the program to select stream impairments by their geographical location. While this process is not sufficient for high-accuracy raster processes required at the stream level, it sufficed for a large-scale approach where regions of interest were 12-digit watersheds or where a Central Appalachian versus non-Central Appalachian classification was desired. These impairments were tallied by stream mileage (where possible) for comparison. Applied to a subset of the impairment dataset (only FIB impairments), this same command gave a summary of the streams impaired for fecal coliform or *E. coli*. This step allowed the comparison of total FIB impairments in Central Appalachia versus those in non-Central Appalachia.

To complete the land use comparison, the 12-digit NHD watershed boundaries were used as zones for tabulating the pixels in the NLCD dataset. This information was joined with impairment information to connect both the impairments and the land use data to one attribute table. These data were exported to Microsoft Excel, where formulas were used to determine what the major land use per watershed was for all watersheds that contained FIB impairments. The original NLCD classifications present in the Central Appalachian region include a list of twenty different categories, which were condensed to eight for the purposes of this project. The categories of land use within the GIS analysis were barren, agricultural, developed, forest, herbaceous, shrub, open water, and wetland.

It should be noted that some limitations are inherent in studying NLCD for such a large area, such as the inability to account for the effects of land usage in upstream watersheds on downstream basins. For this initial inventory of bacterial impairments over a relatively large study region, such effects were assumed to be negligible; but a more in-depth statistical study would be necessary to draw definitive conclusions about land usage at a finer scale. Another point of potential concern for this summary method is the scale resolution itself. For small stream branches, pixels at a 30 meter resolution may not be appropriate for fine-scale analysis. However, here comparisons were made using 303(d)-listed stream data, which generally only involve the main stem of 12-digit watersheds – thus 30 meter scale NLCD data are adequate for the purposes of this preliminary study.

In order to complete the population density comparison, census districts were intersected with watershed boundaries to determine the fractional population density of each watershed. A weighted sum was then calculated for each watershed using the census district fragments to find the average population density for each watershed. From this calculation, watersheds could be selected based on the presence of a FIB impairment using the "select by location" command once again. The population density factor was then binned by 2590 people/km2 (1000 people/ mi2). While this method is limited by its assumptions of even population distribution within districts, an efficient inventory-level study necessitated a rather general approach for reviewing the more than 6,500 12-digit watersheds that comprise the six-state region of interest. In order to more accurately tie population densities to specific impaired streams (i.e., rather than uniformly spread population over an entire census district), a much more in-depth method for geo-locating population would be necessary. This necessity is based on the fact that census districts span several 12-digit watersheds in some cases, while several census districts may fall within a single 12-digit watershed in more developed areas. For a more accurate analysis, individual pixels could be assigned weighted population values according to the level of development within that pixel – and thus population density could be estimated at higher-resolution along impaired streams specifically, as opposed to generalizing about the 12-digit watershed.

A two-step method was used to quantify mining operation proximity to FIB impairments. First, a comparison was made based on the presence of both within the same watershed. Next, FIB impairments within a 25 km (~15 mile) search radius of mining permit boundaries were used to select watersheds that could be mitigation targets. The purpose of this section of the analysis was to quantify the potential effect targeted mitigation efforts by mining operations could potentially have on FIB impairments.

Results and Discussion

For review of the following relationships, it should be noted that these examinations are for inventory purposes and preliminary analysis. To more closely examine any of these issues, formalized hypothesis testing and geostatistical analysis must be performed – which is the aim of ongoing work by the authors. Data collection and organization across six states in and of itself presented several challenges worthy of discussion. Regardless of specific project objectives, oftentimes locating accurate and readily comparable environmental data are a nontrivial challenge prior to the actual analyses, particularly when working across state boundaries. Between the six states reviewed in this study, data comparison required the translation of over 160 different impairment terms into a common terminology. States like Maryland simplified their categories into ten main terms, while states like Kentucky and Ohio listed over 50. Extensive person-to-person discussion with contacts from the individual state agencies was required to ensure the meaning of terms and the compatibility of terms from different states. A central database from which regional GIS data can be acquired would be of great benefit in facilitating geospatial studies on a regional scale. In addition, standardization of reporting formats would facilitate more efficient and accurate analyses.

Beyond basic impairment classification, analysis of available state 303(d) lists reveal that the six states in this region vary widely in their relative levels of completion of surface water assessment (Table 2-2) and in the level of detail associated with those assessments. Some coverage statistics are difficult to compare across states; Ohio and Maryland assess at the watershed level rather than stream segment level, resulting in an overestimation of completed stream assessment. In contrast, Pennsylvania's assessment coverage extends beyond the borders of their state, perhaps in an effort track specific pollution issues originating within their state borders. It should be noted that the impairments included in datasets summarized in Table 2-2 likely represent only a small fraction of the water quality impairments that actually exist in some states, like Kentucky and Virginia, where the assessment of only a small portion (<20%) of surface waters has been officially completed.

Table 2-2. Impaired Stream Miles by States Comprising Central Appalachia

State	Assessment Coverage	Central App. Impaired Streams, any pollutant (km)	Non-Central App. Impaired Streams, any pollutant (km)
Kentucky	11%	1,832.10	2,070.85
Maryland	61%	25 Watersheds*	113 Watersheds*
Ohio	80%	407 Watersheds*	697 Watersheds*
Pennsylvania	110%	8,176.74	3,480.32
Virginia	16%	1,905.27	5,621.00
West Virginia	41%	18,856.07	N/A

**Data only available at the watershed level*

An examination of impairment causes indicates that elevated concentrations of *E. coli* or fecal coliforms account for a large proportion of identified impairments in assessed Central Appalachian surface waters (Table 2-3) but reveal no immediate contiguous trend throughout the region as a whole. Some states have more identified FIB impairments in their Central Appalachian regions versus their non-Central Appalachian regions, while in others the inverse is true. It is important to note that region-specific factors can have a large effect on these results. Assessment coverage (Table 2-3) shows that many streams have not been assessed, so making direct conclusions from this information is difficult. In West Virginia, only one impairment is listed per GIS shapefile feature, but a single stream may have spatially duplicate features that contain additional impairments for the same stream segment. While sweeping statements about FIB impairments cannot be made, it is clear that elevated concentrations of fecal indicator bacteria are not uncommon, and in some states, a major surface water quality issue

Table 2-3. FIB Impairments in States Comprising Central Appalachia

State	Pathogen Impaired	% Regional Impairments Attributed to Fecal

	Streams (km)	Indicator Bacteria	
		Central App.	Non-Central App.
Kentucky	1,813	47	46
Maryland	5,058*	39	31
Ohio	4,123*	22	21
Pennsylvania	3,266	5	12
Virginia	3,364	77	64
West Virginia	787	26	N/A
Total	18,413	32	25

**Numbers calculated by summing NHD stream layers within impaired watersheds*

Table 2-4 suggests that, within the six states that comprise the Central Appalachian region as defined in the AOI, FIB impairments typically are related to a few specific land uses. Watersheds with forest areas listed as the primary land use contain the overwhelming majority of listed FIB impairments – with forested areas accounting for nearly three quarters of all such impairments. It is important to note that while a watershed may be primarily forested, a small rural community with inadequate sewage could still be the primary cause for FIB impairment. It may be that the relationship between a largely forested watershed and FIB impairments parallels the increased incidence of non-centralized sewage disposal practices (septic tanks, straight-piping) in less developed watersheds, though substantial further study would be required to confirm this hypothesis. In Table 2-4, values are given for the percentage of watersheds in each state that contain FIB impairments, classified by land use category. For a watershed to be assigned to a specific land use category, the majority of the area (based on zonal tabulation of NLCD pixels) in that watershed was classified within the given land use category (a condensed version of NLCD classification). In parenthesis, the total percentage of land area in each state is given for comparison.

Based on this data, it does not appear that the trends in FIB-land use category can be simply explained by the overall percentages of watersheds in each category. For example, while approximately 58% of land area in Virginia is classified as forested, nearly 82% of total FIB impairments occur within watersheds that are classified as mostly forested. Indeed, the data gathered thus far make a strong case for examining this relationship further as part of any real efforts to reduce bacterial impairments within this region. Both Maryland and Pennsylvania showed a higher proportion of FIB-impaired waters related to development than the other states. This relationship mirrors the results of studies that point to urban stormwater as another source of pathogens in surface waters (Gaffield et al., 2003). On the other hand, Ohio has a far greater instance of FIB impairments near agricultural land uses, which may point to a variation in agricultural practices or methods of stream assessment between Ohio and other states.

Table 2-4. Statewide FIB impairments (and Overall Land Area) vs. Primary Land Use

State	% of Watersheds Containing FIB impairments where Land Use Category Represents Majority of Pixels in Raster (Overall State %)							
	Barren	Agricultural	Developed	Forest	Herb.	Shrub	Water	Wetland
Kentucky	0 (.37)	37.99 (32.89)	4.17 (7.25)	57.60 (52.14)	0 (4.15)	0 (0.32)	0.25 (1.83)	0 (1.05)
Maryland	0 (.40)	0 (32.01)	33.62 (17.84)	59.48 (33.63)	0 (1.76)	0 (1.76)	0 (1.18)	6.90 (12.89)
Ohio	0 (.19)	68.66 (50.15)	10.45 (14.51)	20.90 (31.18)	0 (1.62)	0 (0.38)	0 (1.03)	0 (0.94)
Pennsylvania	0 (1.30)	0 (2.22)	23.14 (11.37)	48.76 (51.87)	0 (6.56)	0 (3.42)	0 (0.00)	28.10 (23.26)
Virginia	0 (.27)	11.73 (21.40)	4.86 (9.42)	81.64 (58.23)	0 (1.93)	0 (2.57)	0 (1.03)	1.78 (5.14)
West Virginia	0 (.12)	3.17 (9.41)	1.46 (7.66)	95.37 (79.86)	0 (0.09)	0 (1.73)	0 (0.00)	0 (1.12)
Total	0 (.44)	15.92 (24.68)	7.02 (11.34)	74.11 (51.15)	0 (2.44)	0 (1.70)	0.05 (0.85)	2.90 (7.40)

Because the primary land use of a given watershed may not be directly responsible for observed concentrations of pathogen indicators, it is also critical to determine relationships between water quality and population density, as anthropogenic influence is often associated with surface water impairments. By mapping census tracts to 12-digit watersheds, a relationship between the population density of a watershed and the prevalence of FIB impairments could be investigated. The results presented in Table 2-5 along with Table 2-4 suggest that FIB impairments are common in rural areas. Over 85% of FIB impairments in the six states that comprise Central Appalachia were located within watersheds that had fewer than 2560 people/km^2 (1000 people/mi^2). It is important to note that despite this classification, a watershed with a large proportion of forestland could be impaired by pathogen loading from a small, high-density developed area. However, these data again support the idea that a concerted effort to solve rural issues in water quality would most likely target a large proportion of these impairments.

Table 2-5. Statewide FIB impairments vs. Population Density in States Comprising Central Appalachia

State	% of FIB impairments in Watersheds vs. Population Density

	ppl/mi^2 [ppl/km^2]						
	>1000 [>2560]	1000-2000 [2560-5120]	2000-3000 [5120-7680]	3000-4000 [7680-10420]	4000-5000 [10420-12800]	5000-6000 [12800-15360]	6000-7000 [15360-17920]
Kentucky	93.60	3.20	2.20	.99	0.00	0.00	0.00
Maryland	80.49	4.88	4.88	3.66	1.22	2.44	2.44
Ohio	91.04	5.97	0.00	2.99	0.00	0.00	0.00
Pennsylvania	57.27	36.00	4.69	2.31	0.00	0.00	0.00
Virginia	93.47	3.98	1.74	.50	.31	.50	.31
West Virginia	97.76	2.23	0.00	0.00	0.00	0.00	0.00
Total	85.61	9.38	2.25	1.74	.26	.49	.46

The widespread nature of FIB impairments in rural Appalachia, in conjunction with anecdotal reports of inadequate or nonexistent wastewater treatment in rural communities suggests that an intervention is necessary to improve surface water quality. Given the stakeholders in this region and their associated resources, it is clear that expedient and realistic solutions will require novel strategies. Considering the significant presence of coal mining activities in Central Appalachia, and the increasing emphasis on environmental protection and corporate social responsibility by the mining industry, it appears that one viable alternative may include engaging mine operators as stakeholders with a key role to play (Craynon, Sarver, & Robertson, 2012). Such an approach would, however, necessitate identification of and agreement on incentives for all stakeholders involved.

Given the spatial and temporal scales required for surface mining, and the complex topography and hydrology of Central Appalachia, interactions between mining activities and water resources are inevitable. At present, the coal industry faces serious challenges in gaining permits under the CWA – particularly since a new focus has been placed on heretofore unconsidered dissolved solids loadings from mine spoil discharges, and their potential effects on aquatic macro-invertebrates (Cox & Sarver, 2012). The CWA allows for a variety of compensatory mitigation schemes under some circumstances, including water quality impacts of discharged fill material into wetlands or streams (USEPA, 2008), although "in-kind" mitigation has been preferred.

Under an alternative strategy for improving overall regional environmental and human health, the underlying question becomes one of allowing and encouraging stakeholder participation in addressing FIB impairments. Should flexibility be integrated into the CWA permitting process to allow mitigation trade-offs in order to promote holistic water quality management? Such a strategy would require careful prioritization of water quality goals, and careful implementation in terms of trade-off credit valuation and meaningful stakeholder participation, but may well provide net positive impacts for ecological and public health. In relevant cases where scientific data and stakeholder input support holistic water quality management, an opportunity may exist for mine operators and NPDES and other CWA permittees to contribute to efforts to reduce FIB impairments as part of their overall commitment to environmental and social responsibility.

GIS analysis of the relationship between mining activity and FIB impairments is a cursory method of supporting the argument for flexible, targeted mitigation to support overall water quality improvement for the region. Generally, mitigation allowances are limited to the permitted area of mining operation or the stream reach on which the mining operation is located (i.e., only the drainage area potentially impacted by the mine). This narrow focus does not provide flexibility to mine operators (or other CWA permitees) to contribute to sustainable development in the larger region by addressing community issues. A "watershed approach," as increasingly emphasized in contemporary environmental management practices, would certainly broaden potential impacts.

Although FIB impairments are not directly associated with mining, Table 2-6 reveals a significant number of watersheds with mining activities do coincide with FIB impairments. Under an even more holistic "community approach" significant improvements might be realized with long-term benefits to human (and ecological) health and well-being. This type of approach would be aimed at social responsibility, wherein corporate citizens act to benefit the communities in which they operate; and it must be recognized that communities have economic, cultural, social and environmental ties to local industries, whether or not those industries operate within the specific drainage area or watershed occupied by community members. As the "community approach" is far outside the current regulatory framework and typical operating procedures, it is duly noted that adoption would require substantial changes in environmental policy and corporate culture – both of which should be underpinned by significant further scientific analysis.

Table 2-6. FIB Impairment Incidence with Mining Permits in AOI (Central Appalachia)

State	**Comparison of Mining Presence & FIB Impairments**				
	Total Watersheds	Impaired Watersheds	Watersheds w/Mining	Watersheds w/FIB Impairment	Watersheds w/Mining & FIB Impairments
Kentucky	641	406	145	81	26
Maryland*	N/A	N/A	N/A	N/A	N/A
Ohio	663	407	142	143	15
Pennsylvania	1177	708	163	69	14
Virginia	377	293	50	259	39
West Virginia	742	633	352	413	206
Total	3600	2447	852	965	300

**Comparison not made due to lack of mining GIS data*

Table 2-7 and Figure 2-2 illustrate the above arguments for FIB mitigation approaches based on corporate responsibility over those based on narrower criteria in the study region. While a "watershed approach" could potentially impact about one third of the total FIB impairments in the AOI, a "community approach" could significantly increase this impact. For example, by applying a generic 25 km (15 mile) radius to define the "community" around a given mine, it is expected that over three quarters of the total FIB-impairments could be potentially addressed in the AOI. Although this definition of community may be too narrow or too wide on an individual-mine basis (i.e., community-mine associations are in reality very site- and factor-specific), the point is to demonstrate that a more flexible and holistic approach offers greater possibilities for results. In many cases, the economic, social and environmental impacts of mining operations (both positive and negative) cross watershed boundaries; therefore, it seems plausible that serving a community with mitigation efforts for FIB impairments should also extend beyond the watershed of physical operation. Indeed, the case for any flexibility is especially compelling in West Virginia, where even a watershed approach could potentially address half of that states' FIB impairments.

Table 2-7. Potential FIB Impairment Targets for Mining Operations in AOI (Central Appalachia)

State	**Kentucky**	**Maryland**	**Ohio**	**Pennsylvania**	**Virginia**	**West Virginia**	**Total**
% FIB Addressed (In-Watershed)	41.0%	N/A	10.5%	19.0%	14.5%	49.2%	38.6%
%FIB Addressed (25 km radius)	63.5%	N/A	37.8%	69.4%	32.9%	94.4%	76.8%

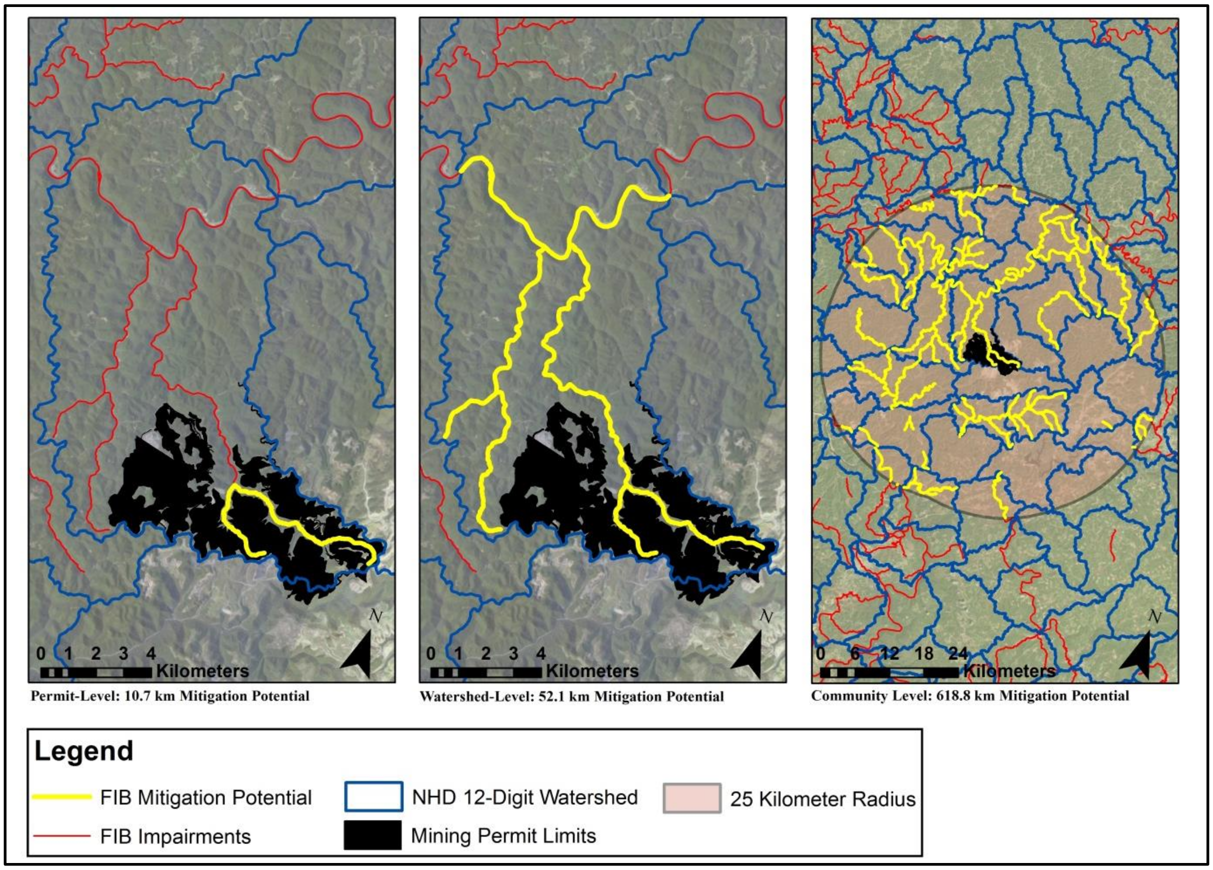

Figure 2-2. Drainage Level, Watershed Level, and Community Level Mitigation Strategies at a West Virginia Example Location

Although sewerage issues may be a primary environmental health concern in some rural watersheds in the Appalachian region, it is worth noting that EPA currently states that the majority of FIB impairments nationwide are associated with agricultural practices (e.g. livestock, manure amendment of soils). Therefore in a broader context, compensatory mitigation, in either a "watershed" or "community" approach, need not be limited to human sewage, but might be utilized to address a wide variety of water pollution sources that are detrimental to ecological stream health. Stream ecology could equally benefit from treatment structures removing pathogens, organic material, and nutrients contributed by agricultural or livestock land uses. Overall, both human health and stream ecology might be improved through the permit-related mitigation process required of mine operators or other permittees. Resources available for mitigation could support the engineering work required to solve relevant water quality issues by implementing solutions (such as installing localized package plants), which could address problems such as *E. coli* presence in streams and poor health scores in benthic macroinvertebrate communities. While the current emphasis on "in-kind" mitigation may be appropriate in terms of hydrology, it overlooks some opportunities for improvement in both human and stream ecology health that a more diverse array of environmental remediation efforts would likely provide.

Conclusions

This initial inventory-level review of bacterial surface water impairments in the Central Appalachian region demonstrated significant challenges associated with the compilation of freely available GIS data at the multi-state level. In both the mining resources and the water quality arenas, differences in data availability (e.g. accessibility, resolution, or non-existence) and formatting proved to be nontrivial pre-analysis hurdles. A collaborative database for natural resource and environmental data would greatly benefit all those who need to analyze data across state lines. Current collection of data in a patchwork fashion ultimately renders geoprocessing difficult and forces significant assumptions during the comparison of heterogeneous datasets. Data manipulation to facilitate comparisons across state lines inevitably introduces some error and uncertainty, as subjective evaluations are required. National formatting and labeling standards would greatly benefit regional studies.

Even if uniform and complete data were available for the targeted study region, the methods and relatively coarse data resolution (i.e., 12-digit watersheds) used here result in certain limitations. To more carefully study many of the relationships of interest would require a statistics-driven approach that includes hypothesis testing and completely raster-based geoprocessing techniques to increase analysis resolution from a general watershed inventory to a localized cause-and-effect study at the stream level. Despite these limitations, some useful initial conclusions can still be drawn from this inventory-level review of the data.

It is suggested by the literature that many FIB impairments are the result of a wide variety of sources, both urban and rural. In the Central Appalachian region, it appears that agricultural practices, wildlife populations, and the use of sub-standard sewage practices (failing septics and straight-piping) are all potential contributors to elevated in-stream pathogen concentrations. By analyzing the data contained in state-available GIS datasets, this variety of stressors seems to be supported by the relationship between land use types (mainly forest and agricultural, some developed) and FIB impairment presence. The GIS data also suggest a link between low population density and the presence of FIB stream impairments. It only takes a single small community lacking sewerage to impair a significant portion of a watershed for pathogens. This phenomenon is both a result of physical geography and economics in the region, and is reflected by the GIS data.

As discussed previously, these potential relationships between water quality and land use suggest possible strategies to address these impairments. Without a municipal tax base, solutions to sewerage issues in these rural areas will have to come from a collaborative effort supported by funding from a joint effort between public and private stakeholders in the region. The proximity analysis highlighted in Table 2-6 and Table 2-7 (as well as Figure 2-2) suggests that coal mine operators in Central Appalachia could make a significant positive impact on environments and communities if encouraged to do so by the relevant regulatory agencies. Moreover, engaging local corporate citizens (i.e., mine operators in the case of Central Appalachia) to participate in local problem solving is critical to sustainable development: near-term economic and societal benefits of industry must be balanced with long-term health and well-being of environments and communities.

Acknowledgements

This study was sponsored by the Appalachian Research Initiative for Environmental Science (ARIES). The views, opinions and recommendations expressed herein are solely those of the authors and do not imply any endorsement by ARIES employees, other ARIES-affiliated researchers or industrial members. Information about ARIES can be found at http://www.energy.vt.edu/ARIES. The authors thank C. Davis for his contributions to this paper.

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CHAPTER 3. INORGANIC CONSTITUENTS OF CONDUCTIVITY IN FIVE CENTRAL APPALACHIAN WATERSHEDS WITH MIXED SOURCE-DRIVEN POLLUTANTS

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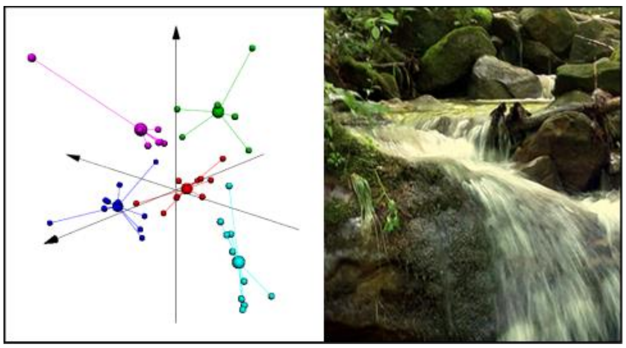
Submitted: January 2015
To: Ecological Engineering
Status: Accepted April 2015

Abstract



Resource extraction activities (e.g. coal mining) are both a dominant economic driver and major ecological concern in the resource-rich region of Central Appalachia in the United States. Additionally, communities near watershed headwaters often lack effective wastewater treatment options and discharge untreated household wastes (UHW) directly into adjacent streams. The present study analyzes data collected from clustered watersheds on the Virginia-Kentucky border, which include sites influenced by discharges from active surface mines, a legacy underground mine, UHW, and minimally impacted (reference) sites. Over two years, in-situ measurements of conductivity were recorded, and grab samples were lab-analyzed for inorganic ion concentrations via ICP-MS. Patterns of detected ions were related to pollution types using a suite of multivariate statistical methods. Concentrations of inorganic ions identified the different pollution types, while permutational MANOVA testing ($p = .001$) to control for pseudoreplication (i.e. multiple sites along the same stream) confirmed that the groups were significantly different from each other. Notable associations were elevated P and UHW, Mn/Si/HCO_3^- and underground mining, and Ni, Ca, K, SO_4^{2-}, and Se with surface mining. Given that mechanisms driving ecological impairments are likely related to specific contributors to conductivity, further efforts to examine relationships between particular ionic concentrations and macroinvertebrates will be useful in watershed remediation efforts in the Appalachian region.

Introduction

The Central Appalachian region of the United States consists of parts of Virginia, Kentucky, West Virginia and Pennsylvania. The region is generally synonymous with coal mining, given a lengthy history of resource extraction. In addition, it is characterized by mountainous terrain and related intricate hydrology, and significant biodiversity including high concentrations of unique plant and animal species (Bernhardt and Palmer 2011). Juxtaposed against the significant environmental resources of the region is longstanding, widespread socio-economic distress as indicated by comparisons of numerous metrics to national averages (e.g. income, education, human health, etc.) (ARC 2011, US Energy Information Administration 2012). The complex interrelationships between environmental, economic, and social factors in Central Appalachia are evident in a host of regional issues, including many of those associated with water quality.

A large number of existing water quality impairments in the region have been associated with current and historic mining activities, which can contribute acidity, metals, sediment, or dissolved solids to streams via surface runoff and/or underground discharge points. The reaction of acids with local formations results in the release of ions common to that geology. Common ions associated with acid mine drainage (AMD) are Fe, Cu, Al, Co, and Ni, while K and HCO_3^- are generally associated with alkaline mine drainage (AlkMD). Both low and high pH discharges from mining are associated with elevated levels of Ca, Mg, Mn, and SO_4^{2-} (Merovich et al. 2007, Lindberg et al. 2011, Bernhardt et al. 2012). Several studies have identified these inorganic constituents from specific sources including sediment ponds (Miguel-Chinchilla et al. 2014), stockpile runoff (Ibeanusi et al. 2003), and underground mine discharges of varying chemistries (Cravotta III 2008), as well as interactions between acid mine drainage (AMD) and stream sediments (Merovich et al. 2007).

Collectively, discharges of inorganic ions contribute to measures of specific conductance (conductivity) in downstream waters. Given several recent studies that link elevated measures of conductivity to losses in benthic macroinvertebrate diversity and abundance (Schmidt et al. 2002, Sloane and Norris 2003, Clements 2004, Freund and Petty 2007, Merricks et al. 2007, Pond et al. 2008, Pond 2010, Cormier et al. 2013), conductivity is increasingly considered indicative of conditions affecting aquatic ecological health. Since these macroinvertebrates generally comprise the lower levels of the food chain in freshwater systems, such losses are considered a violation of the biological integrity standards under the Clean Water Act; stream condition indices (SCIs), which are used by many states to assess in-stream ecological health, are largely based on collective quantification of these organisms (Barbour et al. 1999). Ultimately, remediation efforts, including the development of Total Maximum Daily Loads (TMDLs) in accordance with the US Clean Water Act, focus on identifying specific system stressors related to benthic macroinvertebrate loss; however, the specific mechanisms responsible for species loss are generally complex and not well understood (Benham et al. 2008, Keller and Cavallaro 2008).

Oftentimes, field-scale studies focused solely on observed conductivity measurements do not account for additional potential confounding factors that may co-exist such as habitat loss, development in the riparian corridor, the presence of other pollutant sources, or the actual constituents of the conductivity observed (Schmidt et al. 2002, Sloane and Norris 2003, Clements 2004, Freund and Petty 2007, Merricks et al. 2007, Pond et al. 2008, Pond 2010, Cormier et al. 2013, Ziemkiewicz and Northway 2013). Because of the limited data available, results from these field observations are not always readily comparable to studies attempting to identify maximum permissible levels of conductivity in laboratory mesocosms (Kennedy et al. 2004, Kennedy et al. 2005, Echols et al. 2010, Elphick et al. 2011a, Elphick et al. 2011b). Some attempts have been made to bridge these laboratory studies with field observations in order to explain the relatively high survivability of laboratory organisms at elevated conductivities (~1000 μS/cm) versus obvious species loss at lower levels (~300 μS/cm) in the field (USEPA 2011, Yeager-Armstead et al. 2013). The discontinuous nature of conductivity effects observed in the field and lab studies indicates that setting an effective conductivity benchmark may not be a simple task.

Although mining influences are perhaps the most readily identifiable sources of potential surface water contamination in this region, additional chronic issues related to economic distress may also contribute to losses in biological integrity. Across the more rural areas of the Central Appalachian coalfields, former "coal camp" communities often do not have access to wastewater treatment systems, and the local soils are inappropriate for traditional on-site septic systems. Consequently, the practice of directly discharging untreated household wastewater (UHW) comprised of both sewage and common household chemicals to nearby streams via "straight pipes" is common. Though this practice likely presents public health and ecological health risks, the issue is seldom addressed due to insufficient regulatory and financial resources (Tarricone 1989, Glasmeier and Farrigan 2003, Gasteyer and Vaswani 2004). No prior work has been published that describes the impacts of UHW on water quality or stream health in Central Appalachia, although some efforts are underway to describe mixed landuses (Merriam et al. 2011, Merriam et al. 2013).

In an effort to study the relative effects of local mining activities and UHW discharges, 46 sites located within a cluster of five small watersheds were monitored monthly for two full years (25 sampling trips). Target watersheds were carefully selected to ensure similar underlying geologies. In-situ monthly monitoring of temperature, dissolved oxygen, pH, and conductivity was paired with grab samples analyzed for a suite of inorganic constituents. Subsequent statistical analyses aimed to: 1) identify particular inorganics that drive conductivity increases in this region; and 2) determine whether patterns of inorganic concentrations are distinct between primary known upland sources of surface water contamination.

Methodology

Study Area

Preliminary GIS analysis and field reconnaissance, including meetings with local health agencies and sanitary surveys, were used to select study streams in watersheds of similar underlying geology but distinct primary pollution sources along the border of Virginia and Kentucky. The five study streams are all headwater streams; three are located in the Powell River basin in Wise County, Virginia, and two are located in the Cumberland River Basin in Harlan County, Kentucky. All streams are located in the Cumberland Plateau physiographic region, and are geologically dominated by Pennsylvanian-age sandstones, shales, and coal formations. Land cover is primarily mixed-mesophytic hardwood forest as is typical of Central Appalachian systems, though the extent of forest cover varies with the level of mining activity (50% to > 80%). The proportions of land classified as barren and/or grassland also vary with mining activity, from 19-21% in the watersheds with significant current surface mining footprints to as low as <1% in non-mining watersheds. Developed area in all watersheds is less than 10%, with communities clustered in the riparian corridors as is common for the steep, mountainous terrain typical of the region, which is dissected by small hollows. Land use is described here for illustrative purposes only, but was not formally used in the subsequent statistical analyses.

Target study streams included: Yocum Creek (Lower Clover Fork watershed, 8 sites) and Looney Creek (Looney Creek-Poor Fork watershed, 6 sites) in Kentucky, and Callahan Creek (15 sites), Roaring Fork (9 sites), and Looney Creek (Pigeon Creek watershed, 8 sites) in Virginia (Figure 3-1). Streams were selected to represent four conditions of interest in terms of primary discharge types. Condition 1 ("mining and UHW combination") is represented by Roaring Fork and Callahan Creek, which both have significant surface mining activities in the headwaters as well as UHW discharges from 20-40 homes downstream of mining activities. Condition 2 ("mining only") is represented by Looney Creek Virginia, which also has surface mining activity in the headwaters, but no known UHW discharges; residences along this creek have municipal sewage service provided by the Town of Appalachia. There is also an historic underground mine discharge near the Looney Creek, Virginia headwaters. Condition 3 ("UHW only") is represented by Yocum Creek, which has UHW discharges (3-10 homes) but minimal mining activity in the headwaters. Finally, Condition 4 ("reference") is represented by Looney Creek in Kentucky, which has no current mining activity in the headwaters, and no UHW discharges; there is a municipal wastewater treatment facility discharge point from the towns of Benham and Lynch at the furthest downstream point on the sampled reach of this creek.

Sample Collection

Water quality samples were collected monthly from August 2012 to August 2014 (n=25) at the longitudinally distributed sites along each stream reach (Figure 3-1). Sites were chosen to represent the stream continuum from headwaters to their confluence with higher order reaches, with additional sites selected to highlight inputs from mining discharges and UHW influences. It is worth noting that these study sites were not subject to significant influences from acid mine drainage, as the surface geology of the area is primarily comprised of carbonate formations, lending elevated alkalinity that results in typical stream pH values >7.0.

In-stream measurements of conductivity (μS/cm), temperature (^oC), pH, and dissolved oxygen (mg/L) were taken at each site on a monthly basis with an YSI Quattro Pro Plus (YSI, Yellow Springs, OH; USA), with samples for laboratory analyses concurrently collected in sterilized, acid-washed 250 mL polypropylene bottles. The YSI Quattro Pro Plus was tested monthly before use and calibrated as needed (at minimum quarterly) using triple point pH calibration, single point DO calibration in water-saturated air, and single point conductivity calibration using a certified conductivity standard.

Grab samples were transported on ice to the Biological Systems Engineering Water Quality Laboratory in Blacksburg, VA. A 10 mL subsample was acidified with nitric acid (2%) for ICP-MS analysis promptly after field sampling excursions. In cases of high turbidity and particulate matter (i.e. trips following rain events), samples were syringe filtered using a 0.45 μm Whatman PES filter prior to ICP-MS analysis to prevent instrument malfunction. Table 3-1 includes maximum recoverable limits as well as minimum detection limits for the ICP-MS analysis conducted on these samples. ICP-MS analysis reported S as SO_4^{2-} and Cl as chloride. Data QA/QC included replacing values below minimum detection levels with zero values, as well as checking for anomalies in ICP-MS detection (spikes in observations that indicate problems with the ICP-MS sweep). Because samples were generally unfiltered, results represent total levels of inorganic ions as opposed to dissolved levels. Field blanks were collected and analyzed during each sampling trip to confirm no background sources of contamination. Alkalinity was determined using a HACH Alkalinity Test Kit (Model AL-DT) on an additional 100 mL subsample. The measured alkalinity could then be used to approximate HCO_3^-, since alkalinity in the study streams is dominated by carbonates and measured pH values were generally in the neutral to slightly basic range (i.e., pH 7.0-8.3) such that virtually all carbonate is present as HCO_3^-.

Table 3-1. MRLs and MDLs of Inorganic Ions Analyzed via ICP-MS

Parameter	MRL (ppb)	MDL (ppb)
Aluminum (Al)	0.2	0.055
Arsenic (As)	1	0.212
Calcium (Ca)	50	6.967
Chlorine as Chloride (Cl^-)	200	30
Chromium (Cr)	0.2	0.033
Cobalt (Co)	0.2	0.019
Copper (Cu)	0.5	0.104
Iron (Fe)	50	4.108
Magnesium (Mg)	2	0.294
Manganese (Mn)	0.5	0.017
Nickel (Ni)	0.2	0.052
Phosphorus (P)	20	3.312
Potassium (K)	100	11.7
Selenium (Se)	5	0.49
Silicon (Si)	10	0.800
Sodium (Na)	50	6.212
Sulfur as Sulfate (SO_4^{2-})	1000	400
Zinc (Zn)	1	0.212

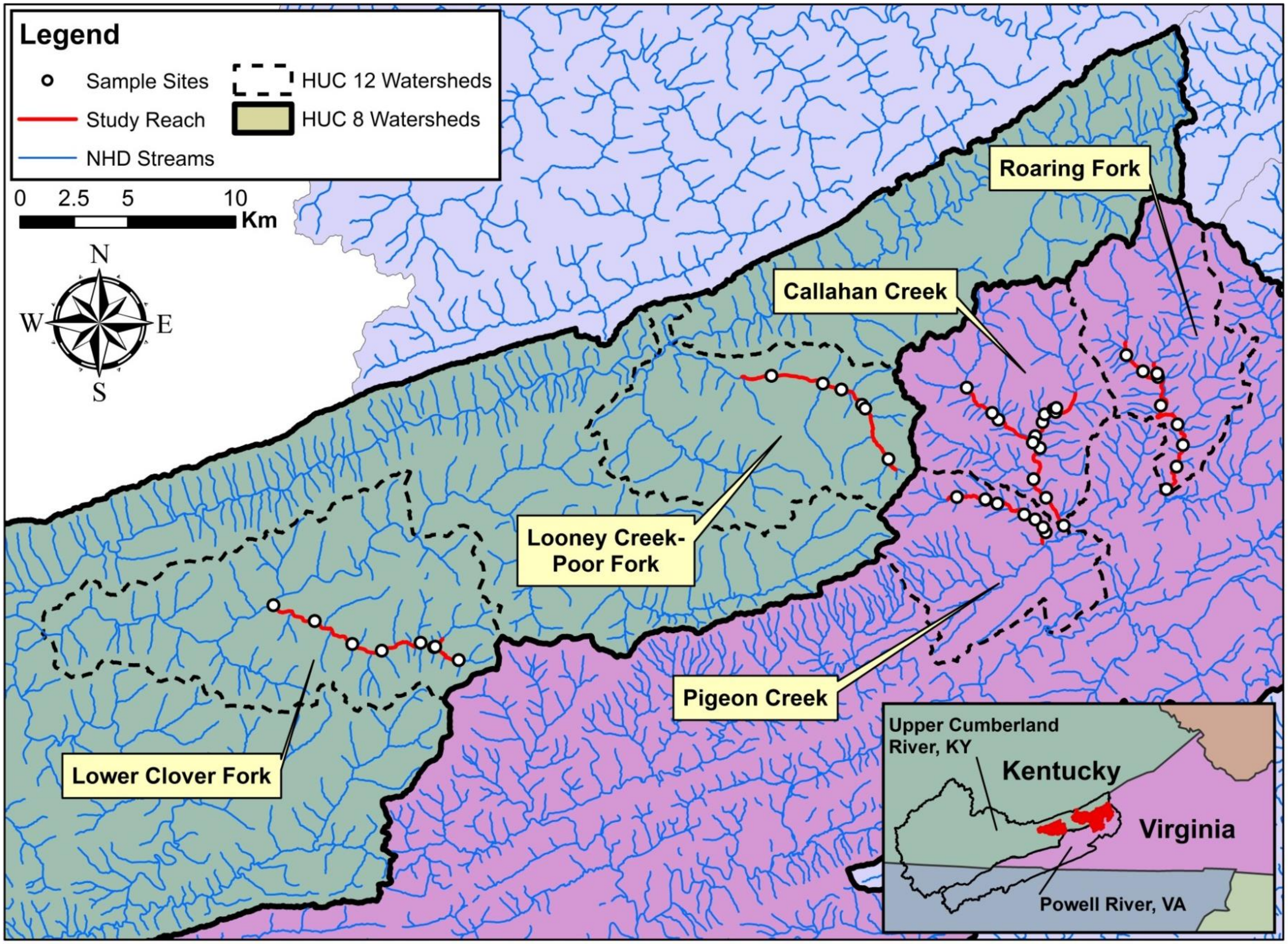


Figure 3-1. Location Map for Study Streams and Sample Sites

Statistical Analysis

Wards' hierarchical clustering (Ward 1963) and Principal Component Analysis (Legendre and Legendre 2012b) were used to determine if study sites grouped by pollution source (mining only, UHW only, a combination of the two, or reference conditions) based on measured ion concentrations using all ions shown in Table 1 (Legendre and Legendre 2012a). No a priori grouping was used in this analysis, thus groups formed based on ion concentrations alone Appropriate statistical methods were used to address inherent pseudoreplication due to longitudinal sampling. Wards' hierarchical clustering is an agglomerative algorithm that begins with all sites as individual groups and iteratively forms larger groups (or clusters) by minimizing the total within-group variance until all sites become a single group. A dendrogram can be plotted to visualize this bottom-up agglomeration process and tell the user the optimal number of clusters. PCA is an ordination technique used to combine the inorganic ion variables into principal components that capture the majority of variation in the data. Only the first few principal components with large eigenvalues (empirically > 1) are kept, so the dimension of data space can be reduced. A scree plot along with eigenvalue magnitudes were used to determine component inclusion in analysis with a loading cutoff of 0.30 used to consider important ion contributions to each component (Legendre and Legendre 2012b). Another common practice is to draw a PCA biplot which combines the scores (showing the relations among observations in the 2-dimension space) and a loading plot (showing relations among variables, and relations between original variables and principal components) (Legendre and Legendre 2012b). Because PCA requires normality in datasets, ICP-MS ions were normalized prior to analysis using a log-normal transformation (Shapiro-Wilks testing indicated the raw data to be non-normal); means of ion concentrations were used for each site (n=25 observations at each site). For the purpose of preventing multicollinearity in the data, conductivity was excluded from the analysis as it is an inherent measure of the sum of all ions. R statistical programming language v2.15.1 was used for all analysis (R Foundation for Statistical Computing, 2012).

Using the groups observed in CA, PCA biplots were used to color sites based on group, illustrating the location of those groups in data space and allowing interpretation of how the individual ion concentrations were important in terms of group membership. As an evaluation metric, classification and regression tree (CART) analysis was used to determine the misclassification rate of group membership in CA. CART is a recursive tree algorithm process, but can accept data with pre-determined groups and run a tree algorithm to determine how accurately those group labels describe observations by recursively running variables through the tree algorithm, beginning with the data as one large group and splitting the dataset into smaller groups while minimizing variance within groups (Fabricius 2000).

In concert with CART, the Random Forest algorithm was used to further understand the importance of individual ions in the grouping process. This technique creates numerous tree structures using processes similar to CART; however, some data is held from the analysis and subsequently used to evaluate each tree (out-of-bag validation). The variable importance and model accuracy of each tree is saved, then variable importance is determined over the entire collection of trees (i.e. "forest"); this is generally considered a more robust process than the singular tree development processes used in CART (Breiman 2001). From this process, further validation is provided for ion importance and thus characterization of how ions drive group membership. The Random Forest method was used to grow 100,000 CART-style trees, for which p/3 variables (where p=18 is the number of total variables in Table 1) were tested at each split in the tree algorithm to determine those variables that most affect the accuracy of splits that determine group membership. The importance of the different inorganic ions was reviewed over all 100,000 trees (the "forest") with the response variable being the group classification determined from CA. These processes were completed using the tree package (CART) and the RandomForest package in R (Liaw and Wiener 2002).

As a final step, permutational MANOVA (PERMANOVA) testing was performed on the CA groups while controlling for stream location. This testing procedure was developed to allow ANOVA to be performed on non-parametric, multivariate data with minimal assumptions and datasets lacking replication; the procedure returns a p-value and F-statistic analogous to Fisher's F-ratio by using either a dissimilarity matrix or symmetric distance matrix along with a permutation procedure to generate a p-value. The procedure also allows for the inclusion of multiple factors either as additive effects, or as partitioned effects (Anderson 2001). By treating sites as replicates within a single factor (stream location), the previous concerns of pseudoreplication via longitudinal sampling could be addressed and group differences statistically verified. PERMANOVA testing was completed using the vegan package in R (R Foundation for Statistical Computing, 2012). Last, a correlation matrix was used to review the relationship between field-observed conductivity values and the lab-analyzed ion concentrations in order to review connections of specific ions and the broad measure of conductivity.

Results

Mean and standard deviation values for all measured ions and water quality parameters in the five study watersheds are provided in Table 3-2. A cursory review of this data reveals two general trends: ionic concentrations are lower in the reference watershed (with the exception of chloride) versus watersheds with UHW and/or significant mining activities, and conductivity is highest in watersheds with mining activity (CC, LCVA, RF). Additionally, the raw data show that within-watershed values are highly variable; this indicates that water quality is site-specific. Using Cluster Analysis (CA), sites could be categorized into five groups on the basis of ion concentrations (Figure 3-2). Based on knowledge of field conditions, three of these groups correspond very well to the categorical classifications of streams by known primary discharges (i.e., UHW alone, combination of mining and UHW, and reference); and the other two groups correspond to mining-influenced sites, with one group being associated with known surface mine discharges and the other being associated with a known underground discharge. Groups are subsequently referred to as "surface mining", "underground mining", "UHW", "reference", and "combination," where "combination" refers to sites downstream from both UHW and surface mining influences.

Table 3-2. Average and Standard Deviation values for measured ions and water quality parameters in each study watershed

Parameter[1]	**CC (n=350)**		**LCKY (n=150)**		**LCVA (n=200)**		**RF (n=225)**		**YC (n=200)**	
Al	69.51	(154)	48.93	(52)	53.61	(116)	45.61	(94)	77.76	(76)
As	0.07	(0.2)	0.03	(0.1)	0.05	(0.1)	0.16	(0.9)	0.06	(0.2)
Bicarbonate[2]	982	(665)	551	(861)	1080	(916)	884	(446)	1833	(2072)
Ca	61838	(16889)	20643	(4787)	63174	(13296)	90691	(17895)	25999	(5749)
Cl	3018	(1769)	7097	(2839)	6303	(2446)	1852	(695)	5104	(34709)
Co	0.23	(0.5)	0.09	(0.1)	0.17	(0.3)	0.52	(3.1)	0.14	(0.2)
CONDUCT	630	(215)	246	(126)	692	(157)	868	(199)	371	(143)
Cr	0.59	(0.9)	0.43	(0.7)	0.7	(0.7)	0.56	(0.5)	0.68	(1.4)
Cu	0.62	(1.2)	0.19	(0.3)	0.39	(0.7)	0.54	(1.1)	0.50	(2.9)
DO	9.7	(2.5)	9.7	(3.8)	8.2	(3.3)	9.4	(2.7)	9.6	(3.5)
Fe	165.02	(333)	92.92	(106)	169.81	(273)	170.4	(234)	104.28	(122)
K	4655	(1273)	2232	(569)	4009	(662)	5521	(870)	2918	(669)
Mg	26737	(8754)	7817	(1613)	29269	(6370)	45954	(11136)	9734	(2501)
Mn	25.13	(34.9)	12.6	(15.5)	91.28	(84.8)	62.32	(44.0)	10.4	(13.8)
Na	62419	(38145)	30436	(30766)	75013	(23925)	69762	(22754)	60208	(39017)
Ni	1.36	(0.9)	0.36	(0.5)	0.79	(0.4)	1.64	(0.5)	0.44	(0.3)
P	5.27	(23.2)	4.55	(8.7)	6	(7.2)	2.62	(5.5)	5.32	(7.8)
pH	8.2	(0.3)	8	(0.3)	8	(0.5)	8.1	(0.3)	8.3	(0.4)
Se	1.73	(1.8)	0.36	(1.0)	0.52	(1.1)	2.29	(2.0)	0.41	(1.0)
Si	2379	(364)	2060	(362)	2753	(406)	2335	(244)	2407	(407)
SO_4^{2-}	248488	(84742)	54178	(15499)	223434	(50953)	403868	(101216)	68061	(18458)
TEMP	12	(5.3)	11.3	(5.2)	12.8	(3.6)	12.6	(5.3)	11.2	(5.8)
Zn	6.02	(5.8)	5.99	(3.0)	5.14	(4.7)	6.97	(4.5)	4.96	(4.4)

[1]All values reported in ppb except Conductivity (μS/cm), pH, DO (mg/L), and Temperature (°C)
[2]n-values for Bicarbonate are CC (n=168), LCKY (n=72), LCVA(n=96), RF(n=108), YC(n=98)

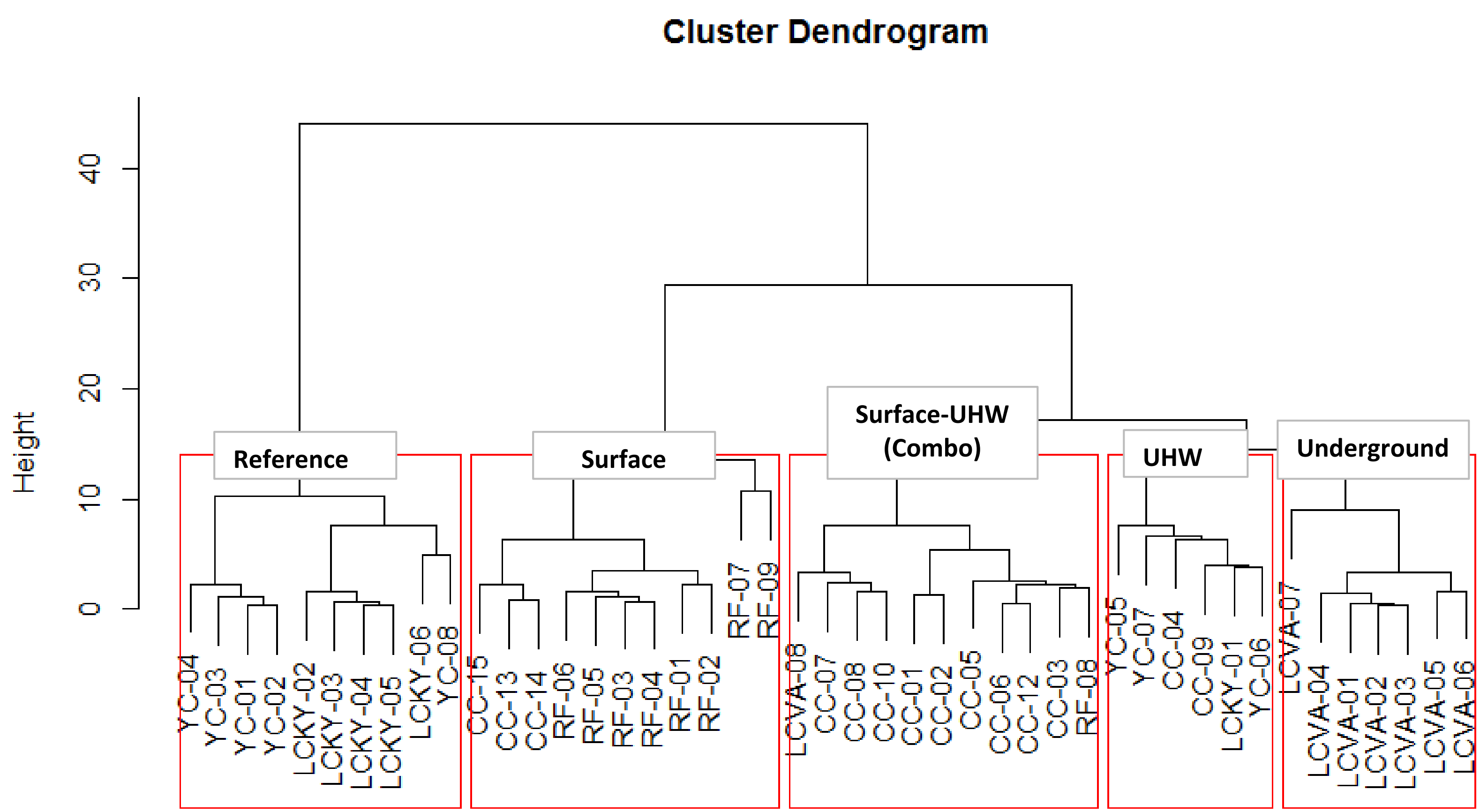


Figure 3-2. Grouping dendogram results from cluster analysis

CART analysis, run to determine classification accuracy from CA, supported these groupings and indicated a misclassification rate of only 2% among the sampling sites. Subsequent Random Forest algorithm results illustrated the inorganic ions important in group formation. The mean decrease in model accuracy related to the permutation of the different variables within the suite of inorganic ions studied is provided in Figure 3-3. The most important ions are at the top of the y-axis; permuting them causes a large change in model accuracy. Importance decreases for ions listed near the origin of the plot. Based on this analysis, Ni, Mn, Mg, Ca, K, and Si appear to be the most important ions, with pairs of ions showing increasingly less influence after this group (HCO_3^- and SO_4^{2-}, then P and Se). A distinct break in the variable importance plot indicates a significant loss of importance.

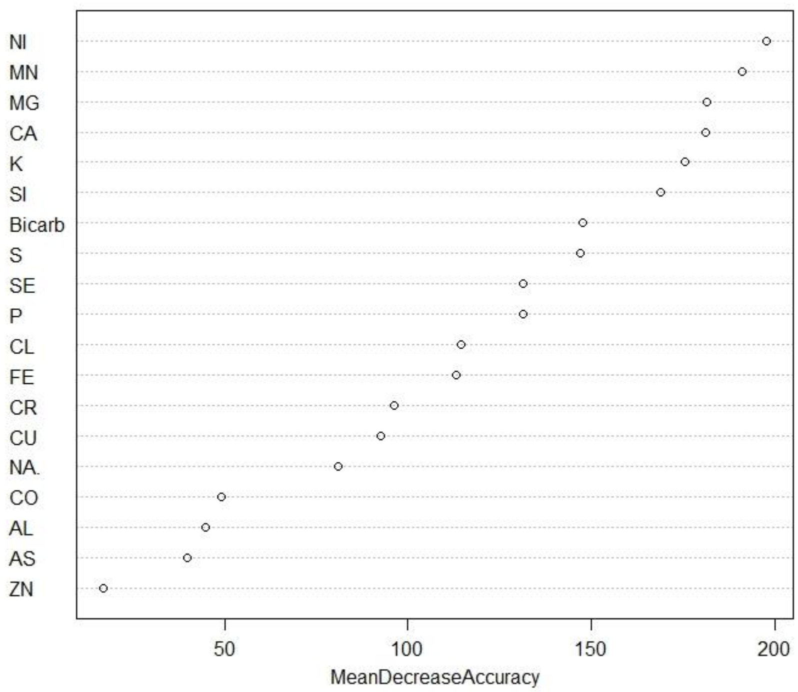


Figure 3-3. Variable Importance plot for Random Forest analysis

PCA resulted in the selection of the three primary components (PC1, PC2, and PC3) as in Figure 3-4 (Table 3 displays variable loadings and PC eigenvalues). Resultant groups from the CA analysis are differentiated by color; small spheres represent individual sample sites, while a large central sphere for each group represents the group centroid in data space. All component axis vectors point in the positive direction. PC1 explained 37.5% of the variance with significant contributions from Se, Mg, SO_4^{2-}, K, Ca, and Ni along the negative direction (moving from reference towards surface mining influence). PC2 explained 19.4% of the variance and is associated with significant contributions from Na, Si, P, Cr, and HCO_3^- in the positive direction (moving towards underground mining and UHW influence). The third PC explained an additional 10.8% of the variance with significant contributions from Mn in the positive direction (towards underground mining influence), while Zn, Al, Fe, and Cu increased in the negative direction (towards UHW influence). Table 3 shows the eigenvalues as well as the variable loadings for each inorganic ion, with values above the cutoff rate of 0.30 highlighted in bold. Taken with Figure 3-4, these values explain how the different inorganic ions push sites into the different groups along PC1, PC2, and PC3. For instance, moving in the negative direction along the PC1 axis, increasing relative concentrations of Ca, Mg, Ni, K, Se, and SO_4^{2-} push sites from the reference group to the combination of (surface) mining and UHW group, and then to surface mining only group.

Table 3-3. Loadings and eigenvalues for the first three principal components (PCs)

Parameter	PC 1	PC 2	PC 3
Eigenvalues	7.134	3.681	2.059
Aluminum (Al)	0.071	0.129	**-0.596**
Arsenic (As)	-0.207	-0.098	0.066
Bicarbonate (HCO_3^-)	-0.151	**0.436**	0.119
Calcium (Ca)	**-0.362**	-0.056	0.092
Chlorine as Chloride (Cl^-)	0.208	0.000	0.092
Chromium (Cr)	-0.059	**0.382**	-0.141
Cobalt (Co)	-0.202	-0.088	0.029
Copper (Cu)	-0.129	0.041	**-0.373**
Iron (Fe)	-0.196	0.098	**-0.389**
Magnesium (Mg)	**-0.356**	-0.074	0.125
Manganese (Mn)	-0.178	0.238	**0.326**
Nickel (Ni)	**-0.331**	-0.139	-0.115
Phosphorus (P)	0.014	**0.374**	-0.134
Potassium (K)	**-0.355**	-0.056	0.008
Selenium (Se)	**-0.300**	-0.186	-0.131
Silicon (Si)	-0.063	**0.426**	0.155
Sodium (Na)	-0.167	**0.406**	0.013
Sulfur as Sulfate (SO_4^{2-})	**-0.364**	-0.069	0.057
Zinc (Zn)	-0.077	-0.063	**-0.316**

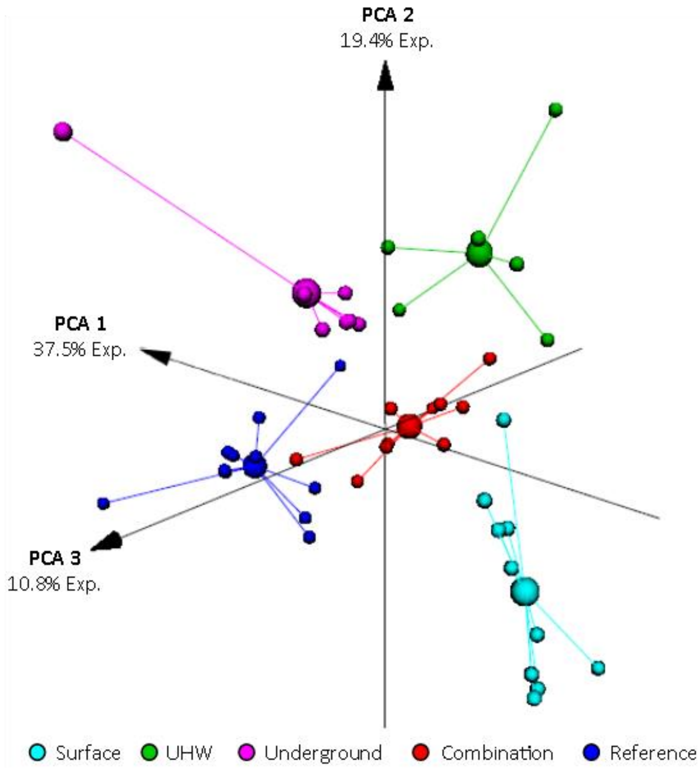


Figure 3-4. PCA 3D plot showing CA groupings

PERMANOVA testing allowed rejection of the null hypothesis that the groups came from a homogenous distribution ($p = 0.001$) with an R^2 of 0.57 and a pseudo-F statistic of 13.27. Therefore, the grouping detected by cluster analysis (CA) explained 57% of the overall variance. This indicates that while the pseudoreplication introduced by the sampling design may lend effects to the grouping observed in CA, the inorganic ions themselves will explain the groupings most effectively. Further, the pseudo-F statistic indicates that the dispersion of group centroids is much larger than the dispersion within the groups themselves, lending support to the CA results. The results of correlational analysis between observed conductivity at the sample sites and measured inorganic ion concentrations are shown in a correlation matrix in Figure 3-5. The correlation matrix suggests that elevated conductivity in these watersheds is most likely a product of increasing Mg, K, Ca, and SO_4^{2-} compounds, as these ions correlate positively with each other and conductivity. To a lesser extent, Se, Mn, and Ni are also correlated with elevated conductivity and with the aforementioned ions most strongly associated with an increase in conductivity. Some additional ions (i.e., Zn, As, Cr, Fe, Cu) appear to be weakly correlated with conductivity. Quantification of the most important ions shown in the variable importance plot (Figure 3-3) is provided by Table 3-4, which provides a summary of the typical values of each constituent in each watershed. For clarity, the highest concentration of each significant element across groups is shown in bold.

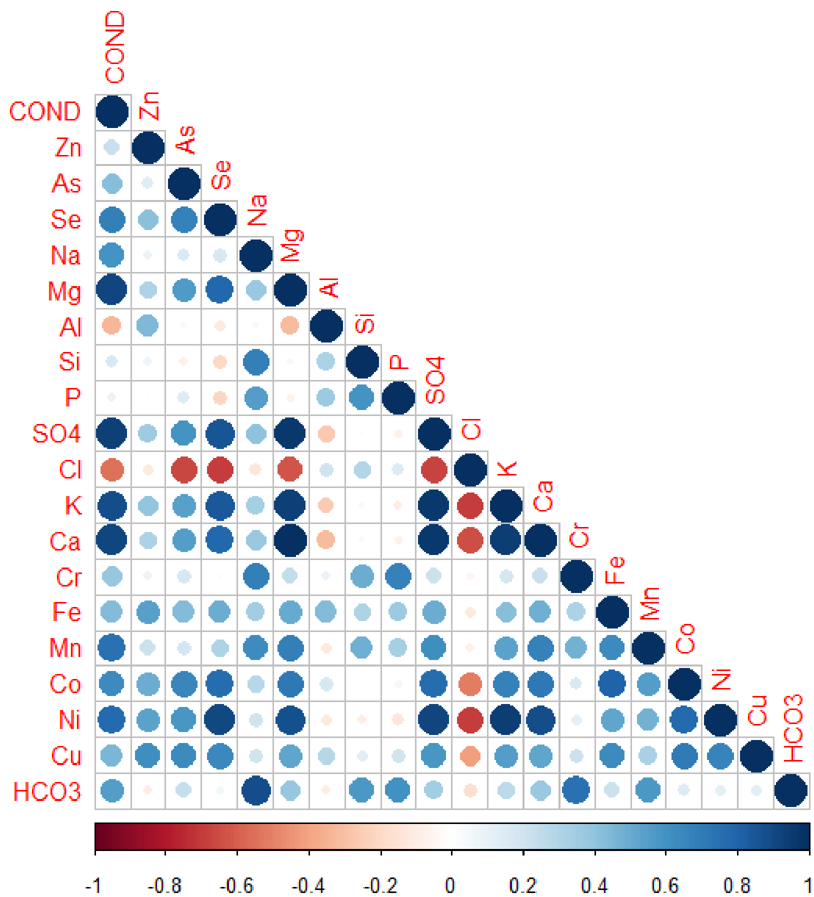


Figure 3-5. Correlation Matrix of Conductivity and Inorganic Ions

Table 3-4. Mean values for significant inorganic ions and conductivity

Cluster	COND*	Ni	Mn	Ca	K	Si	HCO_3^-	SO_4^{2-}	Se	P
Reference (n=10)	264	0.36	7.63	22672	2484	2174	113897	56687	0.37	2.76
UHW (n=6)	562	0.78	22.39	36248	3553	2441	225903	140666	0.85	**11.74**
Combination (n=11)	583	1.14	32.93	58112	4204	2445	153341	230008	1.57	4.15
Underground (n=6)	711	0.77	**94.01**	64074	4052	**2818**	**238641**	225563	0.45	6.10
Surface (n=12)	838	**1.78**	51.89	**89749**	**5718**	2269	179700	**386434**	**2.30**	2.62

*Conductivity reported in µS/cm, all other values in ppb

Discussion

Attempts to describe and predict stream chemistry in the Appalachian region are challenging and complex because of the wide array of inputs, including discharges from various current and legacy surface and underground mining activities (Farag et al. 1998, Merovich et al. 2007, Cravotta III 2008, Lindberg et al. 2011, Timpano 2011, Agouridis et al. 2012), atmospheric sulfur deposition associated with acid rain (Fitzhugh et al. 1999, Chen and Lin 2009), and communities with UHW discharges. In cases where mining activity is a driver in altered stream chemistry, the inorganic constituents can vary, and are often driven by the local geological formations found in concert with coal seams. General carbonate formations and coal seams can contain metals such as Ni, Cu, Zn, As, and Se (Frierdich et al. 2011, Hartland et al. 2011, Frierdich and Catalano 2012, Hartland et al. 2012, Brown et al. 2014), but relative concentrations can vary greatly by location. The presence of chemicals of particular ecological and human concern, such as As and Se, is also geology-dependent as their occurrence with pyrites and other minerals associated with coal seams varies throughout the region (Diehl et al. 2012).

A single relevant study could be found that addressed the effects of sewage on streams in the Appalachian region (Goudreau et al. 1993), though it concerned wastewater treatment plant effluent as opposed to UHW discharges. While some studies have categorized the additive effect of general urbanization in mining-impacted watersheds (Freeman and Schorr 2004, Clinton and Vose 2006, Hedrick et al. 2010, Merriam et al. 2011), this study is the first known to include untreated household wastewater (UHW) as a factor in stream chemistry analysis. Because a primary regulatory concern in regards to mining influence is elevated conductivity and metals contamination, inorganic ions are a particularly relevant metric by which to compare stream conditions from these different pollutant types.

From the analysis above, the primary observation is that the source-driven pollutant contributions to inorganic constituent presence did vary by discharge type and could be summarized by the different groupings of ions through a wide array of statistical approaches. CA indicated that sites downstream of untreated household waste discharges are distinguishable from sites where it is absent, or where mining influence displays an additive effect. Sites with known influence from UHW had an average increase in conductivity from under 300 μS/cm to over 500 μS/cm (Table 3-4). While several important ions increase from reference conditions to UHW conditions as shown in Table 3-4, the increase in P (only nutrient included in suite of ions) supports the presence of organic compounds. Specifically, the suite of ions along PC2 in Figure 3-4 show that sites move from reference conditions to UHW-influenced conditions with increasing Al, Co, Cu, Fe, P, and Zn. Most of these elements are likely associated with surface runoff from developed home sites; however, elemental P is a known nutrient and is most likely associated with household phosphates as well as the organic pollution constituents of UHW discharges.

Along the "mining influence" axis (PC1), Ni and Se are significant in their magnitude, which is consistent with expectations for increased trace metals with increased influence from surface mining operations. AlkMD-associated ions such as Ca, K, Mg, and SO_4^{2-} are also relevant. The interesting observation here is that most of the significant ions are cations as opposed to anions, which may be a result of the neutralizing capacity of local geology and soils (cations are leached from geological formations as AMD is neutralized). It should be noted that none of these ions were observed in mean levels that violated surface water quality standards, but their presence is indicative of source-related conductivity elevation.

CART analysis verified the classification of observed sample sites with a very small misclassification rate. Coupled with Random Forest results, the most important grouping of ions in this process was Ni, Mn, Mg, Ca, K, and Si. This result parallels PC1 and PC2 where AlkMD/trace metals defined surface mining influence along PC1 and Si/Mn distinguished underground mining and UHW influence from reference conditions. Other significant ions included in the PCA analysis appear in two pairs following this first group: HCO_3^-/ SO_4^{2-} and Se/P, again indicating ions associated with AlkMD, underground mining discharges, and UHW.

These pairs show a mixture of important analytes that formed PC2 and PC3. From these analyses it is clear that several different activities can influence conductivity in these watersheds where mining activities are present.

It is likely that changes in water chemistry associated with surface mining and legacy underground mining discharges are primarily associated with elevated conductivity, but the presence of densely-packed homes in legacy “coal camp” clusters influences conductivity as well. In sites on Yocum Creek and Callahan Creek, UHW-impacted sites were also characterized by field-observed macrophyte blooms and conductivity measures consistently above 300 μS/cm, and often as high as 500-700 μS/cm. Downstream measures in conductivity related to surface mining discharges were commonly in this same range, while values in the extensively-mined Roaring Fork watershed were frequently above 1000 μS/cm (as were those downstream from the legacy underground discharge on Looney Creek, Virginia). While most ions characterizing reference conditions were important because of their low concentrations, chloride actually increased in relation to reference sites. Because the reference stream was located in a hollow where one of two local roads over Black Mountain is located, accumulation of road salts may be a possible explanation for this chloride increase. Elevated salinity is often associated with urbanization and the use of road salt (Kaushal et al. 2005, Kaye et al. 2006), clouding the matter of reducing conductivity in mining-impacted watersheds further.

Impaired streams in the central Appalachian region are often characterized by elevated measures of conductivity and reduced measures of benthic macroinvertebrate abundance and diversity; however, a lack of data describing the primary constituents of elevated conductivity renders the mechanistic factors behind species degradation difficult to identify, impeding the design of effective restoration plans. The present study used a variety of advanced statistical techniques (CA, PCA, Random Forest, PERMANOVA, and correlation matrices) to support the hypothesis that patterns of inorganic ions are distinct between reference conditions, UHW-impacted sites, and mining-impacted sites in this sub-region of Central Appalachian Coalfields. In efforts to capture the longitudinal effects of local UHW discharges, multiple sites along each stream were sampled (psuedoreplication); to further support the conclusions of this paper, broader, regional studies should be undertaken where the discharges of interest can be replicated across several watersheds. Using longitudinal sites along a stream gradient can cause grouping results and between-group variation to be dominated by the stream unit itself; based on PERMANOVA testing and known field conditions, this effect was not large enough to confound inorganic ion-driven classification of sites.

It is important to further note that the study watersheds were free of AMD influences and tended towards more carbonate-based mining impacts due to local geology, thus ionic suites will likely vary based on the sub-region of Appalachia. Surface mining disturbances were distinguished primarily by ions that are components of AlkMD (Mg, Ca, K, SO_4^{2-} specifically), although some of these cations are also elements found in abundance in soils (Mg, Ca, K). Both Ni and Se were observed as trace levels. Mean Se levels were below USEPA surface water quality standards, which is worth noting as recent studies have shown adverse biological effects correlated with Se and its bioaccumulation (Farag et al. 1998, Clements 2004, Lindberg et al. 2011, Arnold et al. 2014). In general, it is likely that inorganic ions associated with UHW sites are the results of surface runoff associated with urbanization as well as organic compounds in-stream, while mining influence varied with surface/underground sourcing. Singly or combined, all of the observed pollutant sources elevated conductivity, but did so with differing suites of inorganic ions that could easily be detected using ICP-MS procedures. A broad approach to the characterization of conductivity sources will improve understanding of the specific stressors of macroinvertebrate and related critical remediation needs, and encourage a more holistic watershed-scale approach to improve water quality and ecological health across the region.

Acknowledgements

Special thanks are given to the Appalachian Research Initiative for Environmental Science (ARIES) for funding this work; the Laboratory for Interdisciplinary Statistical Analysis (LISA) at Virginia Tech for assisting with statistical analysis; Travis Lowe and Tim Compton at Appalachian Technical Services, Inc. in Wise, Virginia for field support; and to several students at Virginia Tech who contributed countless hours of lab, field, and prep work including Vickie Nystrom, Sara Gotkurk, Rory Coffey, and Tyler Faulkner.

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CHAPTER 4. HABITAT AND WATER QUALITY AS DRIVERS OF ECOLOGICAL SYSTEM HEALTH IN CENTRAL APPALACHIA

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Submitted: Submitted April 2015
To: Ecological Engineering
Status: Initial review complete, revisions submitted June 2015

Abstract

Ecological mitigation in Central Appalachia often takes one of two approaches: a water quality-driven focus (TMDLs), or a geomorphological focus on stream/habitat restoration (404 permit-related requirements). While often successful at reducing in-stream pollutants or restoring stable hydrology respectively, recent studies have shown that neither approach appreciably improves aquatic ecosystem health. We report here on a field sampling campaign along the Kentucky-Virginia border aimed at identifying primary macroinvertebrate stressors in order to inform ecological remediation efforts and how those efforts might fit into the current regulatory structure. Over two years, we collected 178 observations of benthic species diversity at 36 unique sites representing watersheds of varying surface disturbance and anthropogenic activities, along with associated data from rapid bioassessment protocols (RBPs). Using landuse metrics (derived from GIS data), water quality data, habitat metrics, and stream condition indices, principal component analysis (PCA) identified surface disturbance, forest cover, and specific conductivity as significant variables comprising the first PC. Habitat appears to be a secondary driver affecting community sensitivity with channel alteration, bank vegetation, riparian vegetation, and epifaunal substrate contributing significantly to the second PC. PERMANOVA analysis showed these groups to be significantly different from one another ($p = .001$), $R^2 = .44$. Change point analysis via 500 bootstrapped replications identified shifts in community composition means at 326, 609, and 1065 μS/cm along the conductivity gradient, and habitat change points at 42.6 and 58.2 along the composite habitat gradient. These findings suggest that approaches that improve water quality, upland hydrology, and localized habitat structures may simultaneously be necessary to improve aquatic ecosystem health.

Introduction

The Central Appalachian Region of the United States includes eastern Kentucky, southwestern Virginia, and southern West Virginia (ARC 2011a). While Appalachia as a whole has been a hub of resource extraction (e.g. coal mining, logging) for well over a century, Central Appalachia continues to be a major resource extraction center today. Although the recent boom in natural gas production via hydraulic fracturing technology has resulted in considerable new activity along the eastern mountain chain, other subregions of Central Appalachia are primarily dominated by remnants of past coal mining in the form of legacy sites and abandoned mine lands (US Energy Information Administration 2012). In recent years, there has been increasing regulatory and societal pressure on the mining industry to reduce impacts on water quality and aquatic ecosystems. Concerns for the survival of sensitive aquatic species are particularly intense in this region, as cold headwater streams isolated by steep ridges provide ideal habitats that support a high diversity and density of unique North American species (Palmer et al. 2010a, Bernhardt and Palmer 2011a, Lindberg et al. 2011, Bernhardt et al. 2012).

On a watershed scale, efforts to preserve and restore ecological stability to the region are complicated. Appalachian watersheds are often dominated in the uppermost reaches by resource extraction activities such as surface coal mining, logging, or natural gas extraction, while legacy residential communities (stemming from former "coal camps") can be found just downstream. Because of local economic distress (ARC 2011b), sparse population density, and the lack of distributed population centers in the region, basic sanitation services are often lacking in these communities. Untreated household waste (UHW), consisting of sewage, household cleaning chemicals, detergents, and any other substance disposed of via residential drains, is frequently discharged directly to local surface waters via "straight pipes", further stressing aquatic communities in local streams (Glasmeier and Farrigan 2003, Cook et al. 2013, Cook et al. 2015a, Cook et al. 2015b).

The current framework for addressing impairments to aquatic life in waterways of the United States relies on the Total Maximum Daily Load (TMDL) program within the 1972 Clean Water Act (CWA). Briefly, following the assessment and classification of a particular waterway as "impaired", the TMDL process identifies the ability of the water body to assimilate the pollutant(s) of concern and estimates existing pollutant loadings from different sources. A maximum permissible loading value, including a margin of safety, is identified to meet water quality goals, and the allowable pollutant load is allocated among sources in the watershed (Yagow et al. 2006, Wagner et al. 2007). The development of these plans can be very costly in both time and dollars, actual implementation is not always mandatory, and reviews of these efforts at water quality improvements have shown them difficult to predict and/or guarantee (Birkeland 2001, Freedman et al. 2003, Benham et al. 2008). Further, load reduction plans are generally first focused on permitted discharges, since these discharges be easily quantified and monitored and more easily targeted than non-point source or otherwise unpermitted discharges (Stephenson and Shabman 2001). Oftentimes, implementation efforts have mixed success in reducing the priority pollutants and data demonstrating measurable aquatic life improvement are rare (NRC 2001, Benham et al. 2008, Keller and Cavallaro 2008).

To help quantify the general biological health of stream ecosystems in keeping with CWA goals, a system of benthic macroinvertebrate surveys and rapid bioassessment protocols (RBPs) were developed as numerical metrics for aquatic insect diversity and number, respectively (Barbour et al. 1999). Surveys provide an inventory of species present, while RBPs are intended to quickly quantify the hydrological, physical, and water quality aspects of the environment in which these communities of aquatic insects exist (Rogers et al. 2002). Through these two means, insights can be gained regarding the characteristics of the local environment that may promote or inhibit the success of diverse and abundant aquatic life at locations of interest. While these processes take into account the suitability of sites in terms of a variety of habitat metrics, chemical parameters, and hydrological characteristics, many efforts at site mitigation and TMDL development only aim to address a single most probable stressor (Yagow et al. 2006).

Stream restoration has become a popular mitigation strategy to improve species habitat on reclaimed mine lands in Appalachia. While restoration is generally accepted as effective in terms of stream hydrology (Bernhardt and Palmer 2011b, Ernst et al. 2012, Ramstead et al. 2012), critics have argued that efforts in Central Appalachia have been largely geomorphological in nature and have resulted in little improvement in habitat and water quality (Palmer and Hondula 2014). In other studies, habitat efforts have been included, but ecological effects have still generally been lacking (Bond and Lake 2003, Palmer et al. 2010b, Louhi et al. 2011, Testa et al. 2011, Ernst et al. 2012). Reasons for this vary; the time scale of species recolonization can be long (Bond and Lake 2003), even more so for habitats isolated by steep slopes such as those in Central Appalachia (Pond 2010). Ecological efforts in stream restoration are largely unstandardized (Palmer et al. 2005, Palmer et al. 2010b, Bernhardt and Palmer 2011b), which complicates monitoring efficacy (although biological post-monitoring is a part of 404-permitting).

Recent studies by several field and laboratory researchers focus specifically on water quality parameters – most commonly, specific conductivity or total dissolved solids – as limiting efforts to improve aquatic life in the region (Echols et al. 2010, Pond 2010, Merriam et al. 2011, Timpano 2011, USEPA 2011, Cormier et al. 2013b, Merriam et al. 2013, Suter and Cormier 2013, Yeager-Armstead et al. 2013, Merriam et al. 2015a). Other studies suggest that physical stream stability, in both the structural and geomorphological sense, is the most important factor in promoting the return of species diversity (Asmus et al. 2009, Hall et al. 2014). Mitigation specialists that design stream restoration efforts therefore often combine geomorphological structure with habitat creation in their designs (Palmer et al. 2005, Alexander and Allan 2007, Palmer et al. 2010b, Petty et al. 2013).

Within a single watershed in Central Appalachia, mitigation efforts can often be described as focused on one of two approaches: the TMDL process to address identified water quality impairments (driven by state regulatory programs) and CWA Section 404 permitting as required by the Army Corps of Engineers (ACOE) in relation to local land disturbance activities (driven by industry and associated legal requirements). The TMDL process centers on the improvement of water quality or biological diversity and health (as measured by state-specific metrics) via a watershed approach, while the 404 permit-related activities primarily focus on in-kind replacement of disturbed hydrological function (wetland or stream rebuilding) on mine reclamation sites (although requirements also specify habitat and biological monitoring as well). In reality, neither of these regulatory strategies alone is likely to fully restore stable, functional ecosystems; rather, a coordinated effort to find an optimum intersection of hydrology, physical habitat, and water quality improvements may provide an alternative approach for long-term improvements to aquatic ecosystems.

The goal of the present effort was to explore the effects of both water quality and habitat on benthic macroinvertebrates. Biological and RBP data were collected during a three-year field study of five watersheds on the Virginia-Kentucky border in Central Appalachia. This study analyzed species diversity, abundance, functional feeding groups and pollution tolerance metric data expressed as Virginia stream condition index (VSCI) scores as well as RBP data collected during species surveys for relationships between VSCI scores and the related water quality and habitat data collected in RBPs. By examining these relationships, this study sought to identify the site-specific environmental variables (land use, habitat metrics, water quality parameters) driving variability in VSCI scores, as well as evaluate the existence of threshold values along the gradient of those environmental variables.

Methodology

Study Area

Five watersheds on the border between Virginia and Kentucky were selected for inclusion in a three year monitoring study (Callahan Creek, Roaring Fork, and Pigeon Creek in Virginia; Lower Clover Fork and Looney Creek-Poor Fork in Kentucky; Figure 4-1 and Figure 4-2). These watersheds collectively represent mixed pollutant sources including legacy underground coal mine sources, active and legacy surface coal mining, residential UHW discharges, and highly forested reference areas. All five watersheds drain to headwater streams located in the larger Powell River Basin in Wise County, Virginia or the Cumberland River Basin in Harlan County, Kentucky. The streams are located in the Cumberland Plateau physiographic region; natural land cover consists of mixed-mesophytic hardwood forests, as is typical throughout the Appalachian region (although nearly all forest cover is not virgin timber). Geology is consistent amongst the five watersheds, and dominated by Pennsylvanian-age sandstones, shales, and coal formations. Two types of land cover dominate all watersheds: hardwood deciduous forest and various stages of surface-mining activities (active to reclamation). Forest cover varies between 50 to 90% in the five watersheds, and an inverse relationship is generally observed with the level of surface mining activity including active mining and reclamation areas, which cover between 1 to 50%. Residential area in the watersheds does not exceed 10%, and communities tend to cluster along the stream corridor due to the terrain of the region, where narrow valleys (hollows) are numerous and separated by steep, mountainous slopes. About two thirds of data collection sites were located on the streams' main stems (12-digit hydrologic unit code), and the remaining sites were located along first-order tributary streams within the watersheds.

Data Collection

Certified benthic macroinvertebrate surveys and RBP data were collected at 36 sites over a three-year period from Fall 2011 to Spring 2014. Roughly two-thirds of these sites were being monitored per permit requirements for local surface coal mining operators, in which case data were donated for this study; additional sites were specifically monitored for this study from Fall 2012 to Spring 2014 to increase watershed coverage and site diversity. These 36 unique locations accounted for 178 total observations of RBP characteristics and species diversity. The donated sites were all located in headwater areas coincident with active surface mining permit areas.

Some sites were located on impacted reaches, while others were on undisturbed tributaries as a "reference" site within the given permit. The additional study sites were selected to represent the other parts of the watershed continuum, including sites just up- and downstream from residences,sites at the terminus of the watershed, and upstream reference locations in non-mining watersheds.

In Virginia, the fall sampling season spans late August through early October, while the spring sampling season spans late February through early May. All sites were monitored by a certified consulting firm that performs field monitoring, collection, and species identification to generate reports on behalf of coal operators for VADEQ and the Virginia Department of Mining Minerals and Energy (DMME). Thus, these reports represent the standard of quality required by regulatory reporting at both the state (VADEQ 2010) and federal levels (Barbour et al. 1999).
In brief, benthic macroinvertebrate collection relied upon the single habitat (riffles) method (Barbour et al. 1999, VADEQ 2010), which requires agitation of an area of 0.25 m2 in front of a 500 m mesh kicknet. This process was repeated eight times to achieve a total sample area of 2 m2. Samples were placed in individual containers of 95% ethyl alcohol, labeled, and returned to certified laboratory biologists on staff at ATS for identification. Collected specimens were subsampled in accordance with the standards set forth by the Virginia Department of Environmental Quality (VADEQ 2010), and generally resulted in 300 (± 20%) identified individuals. The Virginia Ecological Data Application System (EDAS) created by Tetra Tech, Inc. (Burton and Gerritsen 2003) was used to rarify family-level identification of species to 110 individuals and generate Virginia Stream Condition Index (VSCI) scores and subscores for each site observation (Burton and Gerritsen 2003). This EDAS system was created by consultants for VADEQ under contract and is the standard system used by VADEQ and reporting environmental consultants to translate raw species counts from RBP data to standardized VSCI scores for reporting to the state and federal agencies. VSCIs are the basis of measuring if a stream meets the "supporting of aquatic life" stream use and can result in the creation of a TMDL. While there is some debate as to the responsiveness of family-level scoring systems to pollution, the VSCI is the current standard for most of the study area and was thus used for comparison and evaluation of sites in this study (Kentucky uses a genus-level system).

Habitat assessments were conducted using RBPs (Barbour et al. 1999), which resulted in scores (i.e., on a 1-20 scale) of 10 habitat metrics: epifaunal substrate, channel alteration, stream velocity/depth regime, flow status, bank stability, bank vegetation, riparian zone vegetation, sedimentation, embeddedness of substrate, and frequency of riffles. Scores from 16 to 20 indicate optimal habitat conditions for a specific variable. For some metrics, both banks are assessed separately (bank stability, bank vegetation, riparian zone vegetation), but the maximum score is still 20 as with the other metrics. Water quality parameters (dissolved oxygen in mg/L, temperature in ^{o}C, pH, conductivity in μS/cm) were measured using a YSI Pro Plus multimeter (YSI, Yellow Springs, OH; USA) at the time of species collection.

Land Use Metric Development
Land use metrics were developed for the five watersheds using ArcGIS (ArcGIS Desktop: Release 10.2. Redlands, CA). The upland drainage area was delineated in GIS for each of the 36 observation sites. National Land Cover Dataset (NLCD 2011) raster pixels were then tabulated to determine the proportion of different land uses within each drainage area. For statistical analysis,

the 11 primary NLCD land use classifications were consolidated into three categories: surface disturbance (S), residential (R), and forested (F). The forested category (F in Table 4-1) solely consisted of the NLCD category for deciduous forest (category 41) which is the natural forest type in the Appalachian region (Pond 2010, Pond and North 2013). While it is true that much of the region has been logged and generally disturbed in the past century, the natural deciduous tree cover in this region provides necessary organic matter (leaf litter) for in-stream macroinvertebrate nutrition that evergreen forest cover does not. Thus, this land use classification represents sites that have recovered from past disturbance (at least in a land use sense) and represent the “most natural” post-disturbance condition. Categories denoting development (21-24) formed the residential category (R in Table 4-1) and primarily consisted of residential development along hollow streams (homes and roads). Barren land (31), evergreen forest (42), mixed forest (43), shrub/scrub (51), and grassland (71) were consolidated to the surface disturbance category (S in Table 4-1); for this study area, these are associated with current or recent surface coal mining activities, previously mined areas undergoing reclamation, or previously reclaimed areas. Non-deciduous forest types comprised a very small percentage of land use in this area, and are historically associated with early post-SMCRA (Surface Mining Control and Reclamation Act, 1977) reclamation efforts. While these efforts could be up to forty years old, if they do not represent pre-disturbance land use (deciduous forest) then they still represent altered land use conditions. These assumptions were made and supported based on field visits to the monitoring areas and comparisons of NLCD (2011) and aerial photography (Bing Maps 2011 via ArcMap). This analysis was consistent with other multivariate analyses of data in the Central Appalachian region (Merovich et al. 2007, Merovich Jr. and Petty 2010). All other land use types were either absent or comprised an insignificant proportion of subwatershed areas (< 0.5%). Table 4-1 shows the relative proportions of the consolidated groups.

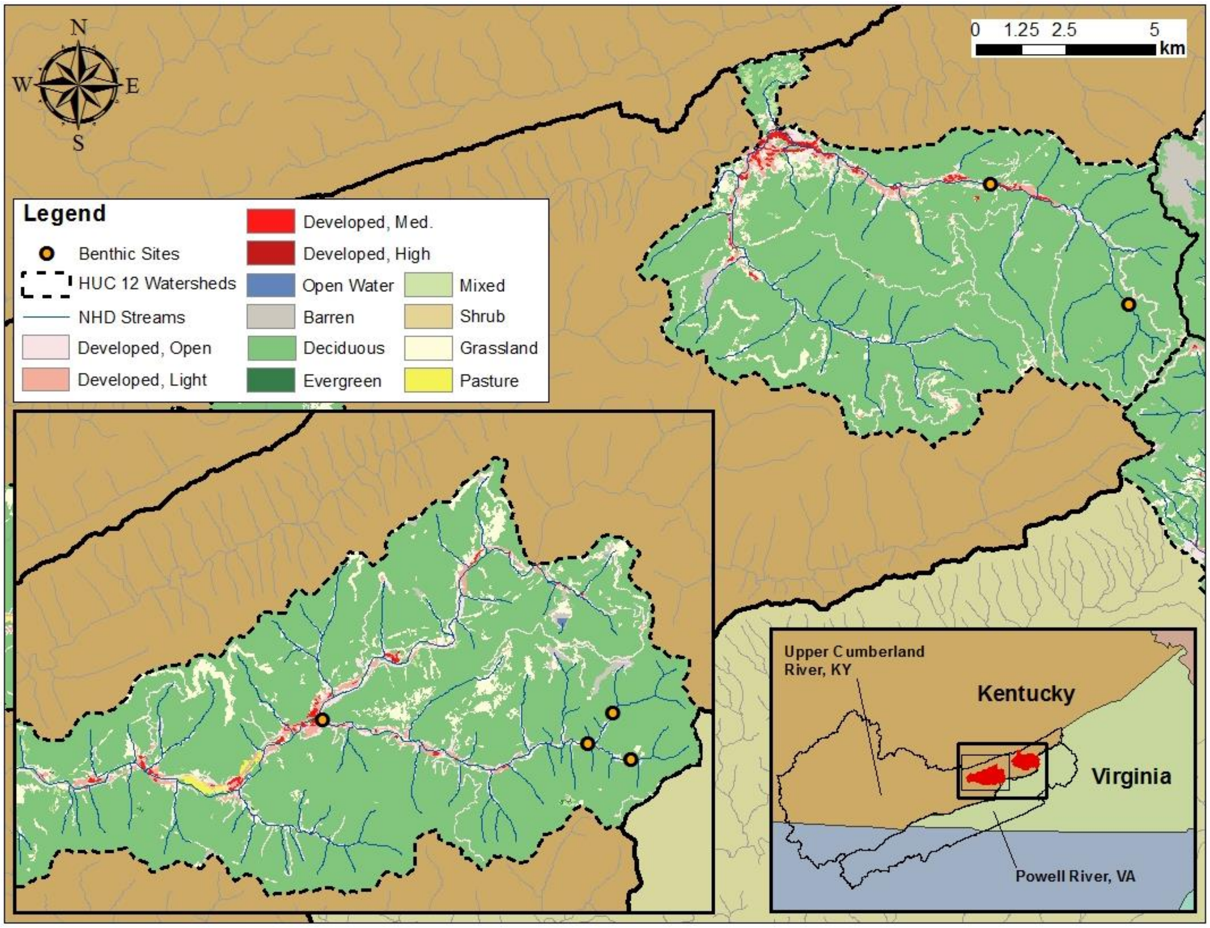

Figure 4-1. Kentucky Study Sites and Land Use

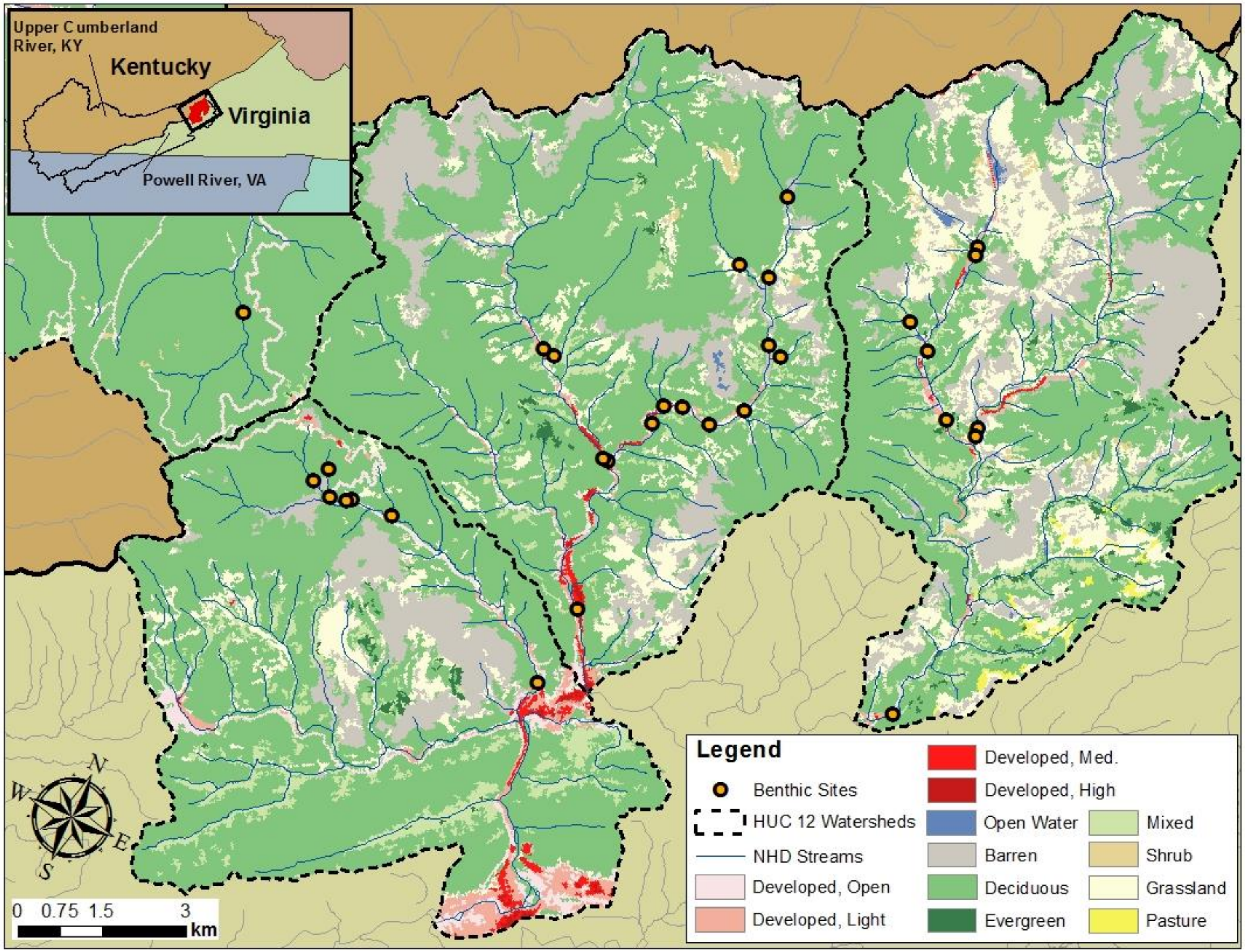

Figure 4-2. Virginia Study Sites and Land Use

Table 4-1. Consolidated Land Use Proportions for Observation Subwatersheds

Watershed	SITE ID	Land Use Metric[†] S	R	F	Watershed	SITE ID	Land Use Metric[†] S	R	F
Looney Creek, VA	LCVA-B01	0.20	0.06	0.74	Looney Creek, KY	LCKY-B01	0.01	0.07	0.92
	LCVA-B02	0.10	0.07	0.84		LCKY-B02	0.01	0.08	0.90
	LCVA-B03	0.09	0.06	0.85	Callahan Creek	CC-B01	0.24	0.03	0.73
	LCVA-B04	0.10	0.05	0.85		CC-B02	0.25	0.01	0.73
	LCVA-B05	0.09	0.10	0.81		CC-B03	0.25	0.01	0.74
	LCVA-B06	0.08	0.11	0.81		CC-B04	0.24	0.01	0.74
	LCVA-B07	0.00	0.14	0.86		CC-B05	0.23	0.01	0.76
Roaring Fork	RF-B01	0.47	0.02	0.50		CC-B06	0.25	0.01	0.75
	RF-B02	0.57	0.02	0.42		CC-B07	0.23	0.01	0.76
	RF-B03	0.57	0.01	0.42		CC-B08	0.20	0.01	0.79
	RFPF-B01	0.42	0.02	0.55		CC-B09	0.15	0.02	0.82
	RFPF-B02	0.46	0.02	0.51		CCWF-B01	0.15	0.00	0.85
	RFPF-B03	0.51	0.02	0.46		CCMB-B01	0.30	0.00	0.67
	RFPF-B04	0.50	0.02	0.47		CCUT-B01	0.36	0.00	0.61
	RFPFWF-B01	0.29	0.00	0.71		CCMLHB-B01	0.14	0.00	0.85
Yocum Creek	YC-B01	0.06	0.06	0.88		CCML-B01	0.25	0.03	0.71
	YC-B02	0.03	0.03	0.94		CCML-B02	0.27	0.03	0.70
	YC-B03	0.02	0.02	0.97					
	YC-B04	0.06	0.01	0.93					

[†]Land Use Metric Key: (S) Surface Disturbance, (R) Residential, (F) Deciduous Forested

Statistical Analyses

All statistical analyses in this study were performed in R (R Foundation for Statistical Computing, 2012). The overarching goal of the statistical analysis was to identify the site-specific environmental variables (land use, habitat metrics, water quality parameters) driving variability in VSCI score and to evaluate the existence of threshold values along the gradient of those environmental variables. First, the above land use metrics, water quality data, and habitat metrics were analyzed using cluster analysis (CA) with Ward's hierarchical clustering method (Ward 1963) to identify groups within the overall dataset. No a priori grouping was used in this analysis to prevent the introduction of bias. The (CA) process is an agglomerative algorithm where all sites begin as individual groups and are iteratively added to larger groups until within-group variance is minimized. Classification and Regression Tree (CART) analysis was employed to quantify misclassification rate in order to determine the accuracy of group placement (Fabricius 2000). To determine the statistical significance of group differences, permutational MANOVA (PERMANOVA) was used with a controlling factor for stream location. PERMANOVA returns an R^2 value and pseudo-F statistic (similar to Fisher's F); the p-value is generated permutationally using 1000 iterations of the algorithm. This method was chosen because replicates represented observations at the same sites seasonally, as well pseudoreplicated sites along longitudinal stream reaches. Habitat metrics were unlikely to be affected by these conditions, but species presence and water quality parameters may have been. By controlling for stream location, this method can test the null hypothesis that the groups came from a homogenous distribution and were statistically indistinguishable (Anderson 2001). Subsequently, principle component analysis (PCA) was used to determine significant land use metrics, water quality parameters, and habitat metrics driving group membership. Because PCA returns optimal results with normal multivariate distributions, data were scaled in R (R Foundation for Statistical Computing, 2012) prior to PCA analysis. PCA is an ordination process used to reduce the dimensions of multivariate datasets to a smaller number of dimensions, with variables (land use metrics, water quality parameters, or habitat metrics) forming elements of each principal component. Using a scree plot and the values of the eigenvalues related to each component, the number of significant principal components can be determined (Legendre and Legendre 2012). PCA analysis returns variable loadings, which refer to the contribution of each variable to each principal component. If each principal component represents a directional gradient in simplified data space, then variables with high loadings contribute significantly to the position of sites in that space. Group membership is determined by the location of sites in data space, therefore a link can be made between variable influence and group membership. To look at the relationship between these variables and aquatic ecosystem health, VSCI scores considered "passing" were mapped to the biplot to search qualitatively for trends. The original document establishing the VSCI system showed statistically lower VSCI scores in the coal-mining region of Virginia versus other non-coastal regions and attributed this fact to the long history of resource extraction (both logging and mining). (Burton and Gerritsen 2003). This same report suggests the minimal passing VSCI score be set at 61, with a standard deviation of ± 6. In state-generated guidance, > 72 is considered excellent, 60-72 good, 43-59 stressed, less than or equal to 42 severely stressed (VADEQ 2010). Because of this distinction and the suggestion that Central Appalachia may be a low-end outlier (lowest 25% quartile) as a region, the lower confidence interval (55) of the passing threshold was used to define passing sites in this study as a "good" classification is the minimum required to avoid TMDL generation for aquatic impairment. To better quantify trends between PCA-identified variables, PERMANOVA testing was used to compare passing VSCI scores to failing VSCI scores. Results showing these two groups as different motivated further analysis using change point/threshold value techniques.

Often in environmental communities, the gradient of specific environmental variables can lead to sharp differences in aquatic ecosystem health. To investigate the possibility of these trends in VSCI scores within the study data, variables above the loading cutoff limit (0.30) from the PCA results were examined using change point analysis nested in a bootstrapping algorithm such that change points could be reported along with 95% confidence intervals. Change point analysis is often used in ecology to evaluate a response variable along the gradient (from small values to large) of some environmental characteristic of interest (Petty et al. 2010, Pond 2010). If changes in the mean of the response variable appear to segment at specific points, these positions in the data were marked as change points. By running the algorithm repeatedly (bootstrapping), verification of the validity of these change points was accomplished with confidence intervals. Change point analysis with 500 iterations was used to develop these confidence intervals. VSCI scores were transformed using the square root function to give a normal distribution (Shapiro-Wilk Test, $p > 0.05$, $W = 0.98$) because the assumption of normality is consistent with optimal model results (Scott and Knott 1974)..

Results

Analyses via CA processes returned five distinct groups among observation sites (group means for all variables provided in Table 4-2). Subsequent CART analysis indicated that grouping results achieved approximately 90% accuracy, and PERMANOVA analysis rejected the null hypothesis ($p = 0.001$) with an R^2 of 0.44 and a pseudo-F statistic of 33.6. The null hypothesis stated that the groups would be statistically homogenous, with stream as a control factor removing watershed location as a confounding factor. This indicated that the group membership explains a large amount of the variance in the dataset and that the groups are statistically significant. The PERMANOVA results specifically ruled out the confounding factor of stream or watershed location, indicating that grouping occurred primarily because of the variables included in analysis. From the group means, it appeared that Group 1 generally represented reference conditions, with a high proportion of forest cover (vs. other groups), low proportion of surface disturbance, the lowest in-stream conductivity, and relatively high average habitat scores. On the other end of the spectrum, Group 5 represented the most highly impacted sites with the lowest forest cover, highest surface disturbance, highest conductivity, and variable habitat scores. Groups 2 and 3 represented mixed conditions with varying surface disturbance, conductivity, and habitat scores; both groups contained passing VSCIs but with different combinations of water quality, land use, and habitat. Finally, Group 4 represented a seasonal shift from Groups 2 and 3; Group 4 included fall observations with higher temperatures, elevated conductivity, and moderate forest cover and surface disturbance.

Table 4-2. Average Environmental Variables (and VSCI metrics) for CA Groups

Variable	Group 1	Group 2	Group 3	Group 4	Group 5
n	25	44	23	59	27
Water Quality Measures					
Dissolved Oxygen (mg/L)	11.7 (2.8)	12.5 (1.5)	12.7 (1.6)	9.8 (1.2)	11.2 (2.0)
Temperature (°C)	9.6 (5.3)	8.00 (3.4)	8.2 (3.6)	16.2 (3.2)	12.6 (4.9)
Conductivity (µs/cm)	406 (221)	451 (188)	659 (305)	788 (306)	1,123 (332)
pH	7.65 (1.31)	8.24 (0.27)	8.26 (0.21)	8.26 (0.29)	8.22 (0.18)
Habitat Assessment Metrics (Score out of 20)					
Channel Alteration	13.9 (2.0)	11.5 (1.9)	14.9 (1.8)	12.6 (1.8)	12.6 (2.1)
Bank Stability	14.6 (1.6)	14.6 (1.9)	15.0 (1.3)	14.2 (1.5)	13.5 (1.6)
Bank Vegetation	14.8 (2.6)	12.8 (2.9)	16.2 (1.2)	14.1 (2.2)	13.3 (1.7)
Embededness	13.5 (1.5)	13.0 (1.2)	13.7 (0.9)	13.0 (1.2)	13.3 (0.7)
Flow Regime	13.3 (3.1)	15.0 (.15)	15.1 (0.5)	14.9 (0.7)	14.8 (0.7)
Riffles	13.9 (1.6)	12.8 (1.2)	14.3 (1.0)	13.1 (1.2)	11.8 (1.6)
Riparian Vegetation	13.5 (3.6)	9.9 (3.4)	16.0 (1.7)	12.7 (3.6)	11.7 (1.5)
Sedimentation	11.8 (2.0)	12.1 (1.3)	13.6 (1.3)	11.6 (1.4)	11.8 (1.5)
Epifaunal Substrate	14.4 (1.9)	13.5 (0.9)	15.0 (1.3)	14.3 (1.4)	13.6 (1.2)
Flow Velocity	11.4 (2.2)	10.4 (0.9)	11.5 (2.0)	10.6 (1.2)	10.2 (1.0)
Land Use Metrics					
Surface Disturbance %	0.09 (0.09)	0.17 (0.09)	0.28 (0.12)	0.18 (0.09)	0.48 (0.08)
Residential %	0.08 (0.04)	0.03 (0.03)	0.01 (0.01)	0.03 (0.02)	0.02 (0.01)
Forested %	0.83 (0.06)	0.81 (0.09)	0.70 (0.12)	0.79 (0.08)	0.49 (0.08)
VSCI Score Metrics (Not used in CA analysis)					
VSCI Score	63.7 (14.6)	55.1 (14.5)	54.6 (14.2)	46.4 (10.8)	34.4 (9.8)
PASS (%)†	18 (72%)	20 (45%)	10 (43%)	16 (27%)	1 (4%)

† "#Pass" refers to the number of sites where VSCI ≥ 55

*All values in parenthesis are standard deviations (except the "PASS" row, which is percent of total)

The variable loadings (i.e., contributions to PCs) are shown in Table 4-3 and displayed in Figure 4-3. The PC1 axis was dominated by land use and conductivity, while PC2 was dominated by land use and conductivity with the addition of habitat metrics: channel alteration, bank vegetation, riparian zone vegetation, and epifaunal substrate. For the remainder of this discussion, the term composite habitat will refer to the summed habitat metrics from PC2. The final axis, PC3, was significant and captured the seasonal variability between site observations (e.g. spring vs fall observations).

Table 4-3. PC Loadings and Eigenvalues

Variable	PC1	PC2	PC3
Eigenvalues	3.14	2.54	2.01
DO	0.15	-0.13	**0.61**
TEMP	-0.18	0.21	**-0.56**
CONDUCT	**-0.34**	**0.30**	-0.14
pH	-0.10	0.11	0.00
ALTER	0.19	**0.40**	0.10
BANKS	0.20	0.03	-0.01
BANKVEG	0.25	**0.31**	0.03
EMBED	0.10	0.24	-0.06
FLOW	-0.05	-0.01	0.26
RIFFLES	0.25	0.10	0.03
RIPVEG	0.25	**0.39**	-0.01
SEDIMENT	0.16	0.22	0.14
SUBSTRATE	0.27	**0.30**	-0.03
VELOCITY	0.13	0.19	0.10
SURFACE	**-0.43**	**0.30**	0.26
RESIDENT	**0.30**	-0.08	-0.25
FOREST	**0.40**	**-0.31**	-0.23

Using the PC loadings as a guide, the differences illustrated by the PCA biplot provided in Figure 4-3 can be identified. The upper left quadrant (- , +) was the region of highest surface disturbance and conductivity (Group 5), while the lower right quadrant (+ , -) was the region of highly forested sites with less surface disturbance and lower conductivity (Groups 1 and 2). From the lower left quadrant (- , -) to the upper right (+ , +), habitat metrics from PC2 ranked from lowest scores to highest scores. Adding passing VSCI scores to the PCA biplot illustrated that a separation could be made along the gradient of land use and conductivity from (+ , -) to (- , +), with fewer passing VSCI scores at high surface disturbance and elevated conductivity.

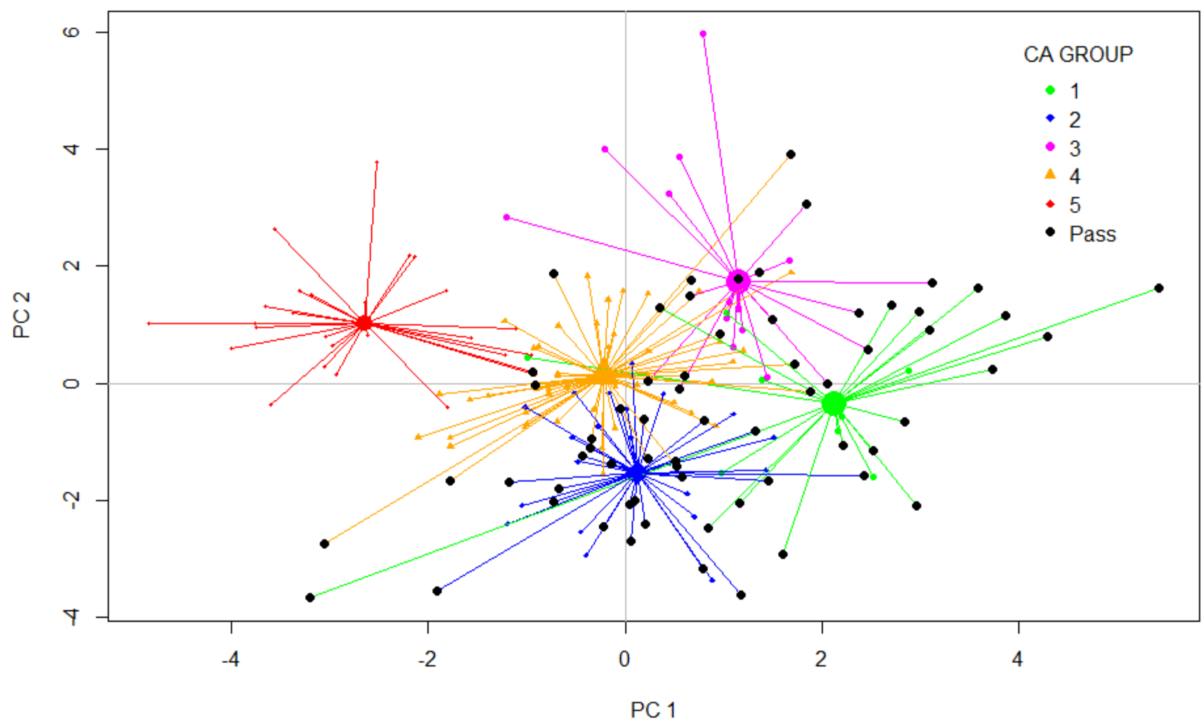

Figure 4-3. PCA Biplot with CA Groups (and Centroids), VSCI Scores (Pass refers to sites with VSCI ≥ 55)

From Figure 4-3, it appeared that from the lower right quadrant (+ , -) to the upper left quadrant (- , +) there was a zone within the plotted data where VSCI scores were primarily below 55. This pattern may indicate a threshold where surface disturbance and/or conductivity reach a level unacceptable to aquatic species at which VSCI scores shift from passing to failing. Along the habitat gradient from the upper right quadrant (+ , +) to the lower left quadrant (- , -) there appeared to be an effect where a group with higher average surface disturbance and roughly equivalent conductivity (Group 3) included proportionally more passing scores than Group 4. Concurrent PERMANOVA testing indicated that the passing and failing VSCI groups did differ based on conductivity, surface disturbance, forest cover, epifaunal substrate, channel alteration, riparian vegetation, and bank vegetation ($p = 0.001$) with an R^2 of 0.32 and pseudo-F statistic of 82.15.

Table 4-4. Results of Change Point Analysis with 95% CI

Change Point	Mean	Upper CI	Lower CI
Conductivity			
CP1	326	327	325
CP2	609	611	607
CP3	1,065	1,068	1,061
Habitat			
HP1	42.6	42.7	42.5
HP2	58.2	58.4	58.0

The change point analysis algorithm suggested five total change points. Three change points were identified along the conductivity gradient at 326, 609, and 1,065 µS/cm, while two change points at 42.6 and 58.2 were identified along the composite habitat gradient (Table 4-4). Figure

4-4 shows these change points in habitat-conductivity space, illustrating bands of conductivity and habitat scores where both variables seemed to contribute to the likelihood of a VSCI score being greater than 55.

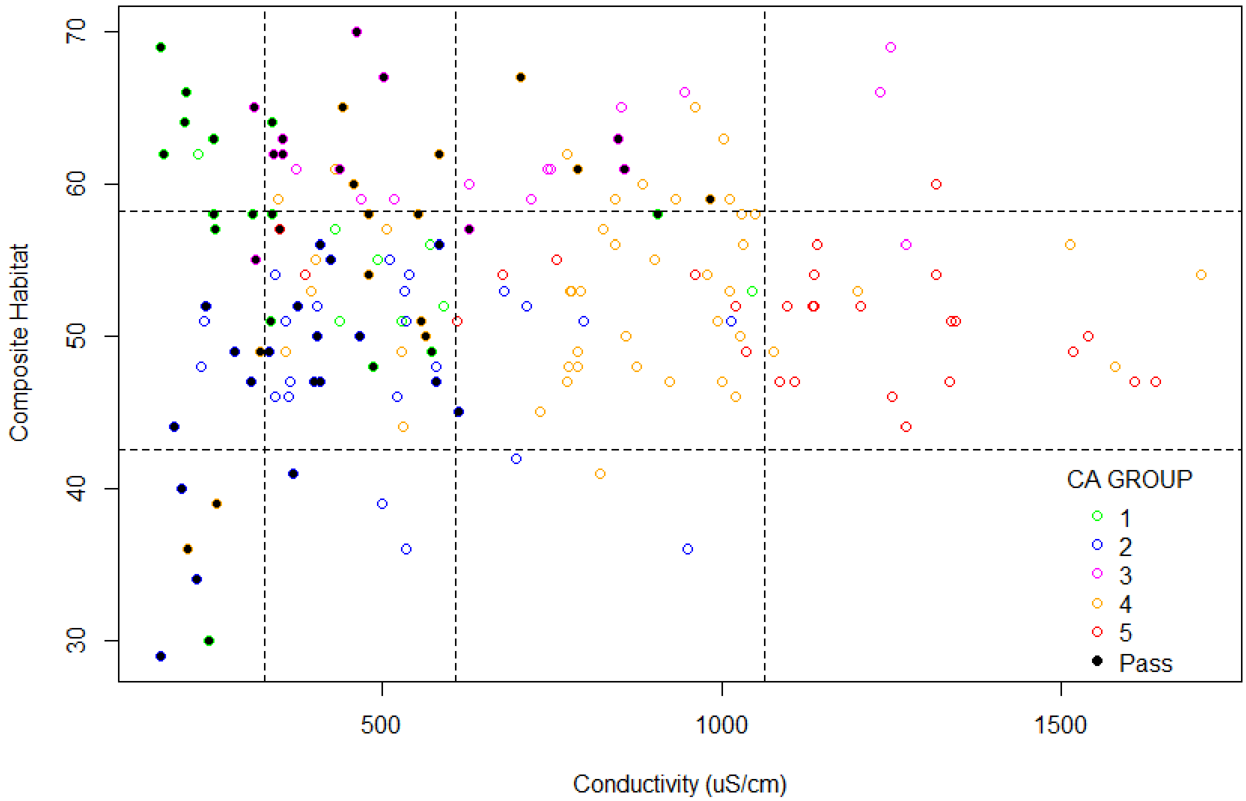

Figure 4-4. VSCI Scores in Conductivity-Habitat Space with Change Points

Discussion

The CA and PCA confirmed some primary findings of previous studies: in-stream conductivity generally increased and VSCI scores generally decreased with upland surface disturbance. Conversely, as forest cover increased, conductivity generally decreased and VSCI scores increased. However, further analyses indicated that while conductivity was an important variable in predicting ecosystem health, it was not the only factor significantly influencing VSCI scores. A second PCA axis of significant variable loadings included major habitat metrics: channel alteration, bank vegetation, riparian vegetation, and epifaunal substrate. It was surprising that neither embeddedness nor sediment was significant habitat metrics, but this may be a result of two factors: 1) the biological sampling at riffles and 2) the slope of the stream. Very little sediment accumulation at riffles was found due to the swift movement of water. At low levels of upland disturbance, composite habitat did not seem to play an important role in terms of VSCI score, but as disturbance increased, habitat became an important factor driving biological integrity.

Along the conductivity gradient, two important change points were identified that agreed with several recent studies of benthic macroinvertebrate response to conductivity in both field and lab settings. The work of Cormier (Coffey et al. 2013, Cormier and Suter 2013, Cormier et al. 2013a, Cormier et al. 2013b, c, Suter and Cormier 2013) and others (Schmidt et al. 2002, Elphick et al. 2011, Gangloff et al. 2015) suggest that the average conductivity threshold resulting in a 5% loss of sensitive EPT taxa species is approximately 300 μS/cm, which is slightly lower than the lowest change point in our analysis (326 μS/cm). It should be noted that the field studies developing the 300 μS/cm threshold were based in watersheds in West Virginia, where water quality impacts from mining activities tend to be dominated by acid mine drainage. The streams investigated in this study were conversely dominated by alkaline mine drainage effects due to the underlying geology (Cook et al. 2015b) which lends itself to a different suite of inorganic ions and higher water hardness. Water hardness has also been shown to be a factor in benthic sensitivity to elevated conductivity (Kennedy et al. 2004, Kennedy et al. 2005). Both field (Freund and Petty 2007, Merricks et al. 2007, Pond et al. 2008) and lab studies (Kennedy et al. 2004, Kennedy et al. 2005, Echols et al. 2010) in a variety of locations have observed extreme species lost in conductivities above 1,000 μS/cm, which is slightly lower than the highest change point in our analysis (1,065 μS/cm). Our work identified a third change point at approximately 600 μS/cm, suggesting there may be a mid-point where composite habitat may affect the sensitivity of benthic macroinvertebrate communities to conductivity alone.

Two change points were identified along the composite habitat gradient using the PCA-identified habitat metrics of statistical importance: channel alteration, bank vegetation, riparian vegetation, and epifaunal substrate. The first of these change points was representative of highly degraded habitat: very few passing VSCI scores are found below the 42.6-level change point from sites unless water quality is essentially pristine (e.g. very low conductivity). Along a second band between the low-end change point at 42.6 and the high-end change point of 58.2 was a band of moderate habitat where some sites attained passing VSCI status at conductivities up to the second change point of 609 μS/cm. At optimal habitat above the high-end change point at 58.2, more sites attained passing VSCI status up to 609 μs/cm, with some at even higher conductivities. It should be noted that the composite habitat gradient contains four of the scores that are rated from 1-20, such that a score of 60 and above represented conditions where each of those four categories were on average in optimal condition (> 15); therefore, the upper-end change point of 58.2 represents a break point where, on average, the important habitat categories were excellent.

Despite documented stream restoration efforts on mined lands in Central Appalachia (Palmer and Hondula 2014), few projects demonstrate significant, measurable improvements in aquatic biological integrity. The lack of documented biodiveristy improvement may be in part the result of inherent tensions in the seemingly separate strategies of the TMDL and 404 permit-related stream restoration processes. The TMDL process is designed as a watershed-scale approach to reduce pollution loadings and thus improve water quality, but it is not necessarily designed to address habitat restoration (e.g. reductions in sediment load from disturbed lands may or may not include downstream bank stabilization efforts). In contrast, stream restoration and mitigation efforts associated with the CWA Section 404 permit program focus on designing stable channels with habitat structures and healthy riparian zones, but restoration as mitigation is not meant to explicitly address upstream pollutant sources.

It appears that a combination of the processes used in TMDL and stream restoration processes is needed to increase benthic macroinvertebrate diversity and density. The results from this study of sites in varying conditions support the need for both water quality and habitat improvements. Change point values for conductivity and habitat observed here suggested that a failure to include and integrate both of these strategies may return mixed results. Improved water quality parameters alone will not foster healthy aquatic ecosystems in Central Appalachia; appropriate habitat must be provided to support a diverse species composition, as has been noted in studies of restoration efforts in multiple ecoregions of the United States (Rogers et al. 2002, Asmus et al. 2009, Slye et al. 2011, Burdon et al. 2013, Hall et al. 2014). At the same time, adding habitat diversity to hydrologically unstable stream systems is also ineffective (Palmer et al. 2010b, Testa et al. 2011). These parallel observations indicate that site-specific biological density relies on acceptable upstream hydrology and water quality, while local habitat diversity is supportive of species diversity. In other words, the water quality and hydrology create an environment in which general aquatic life can thrive, while habitat diversity provides a greater variety of micro-environments that are supportive of species with specific habitat needs.

Conclusions

The key habitat metrics identified in this study were consistent with those needed for habitat diversity: bank and riparian vegetation structures provide underwater root systems, fallen organic debris, and shade. Unaltered channels and diverse epifaunal susbstrate provide a variety of pools, riffles, and eddies along with interstices and rock surfaces. These important habitat structures are products of natural geomorphic processes in stable channels surrounded by healthy native vegetation (Voshell 2002). Our findings also support numerous prior studies that identify key water quality metrics that may negatively impact ecology, including conductivity. However, conductivity can be difficult to ameliorate due to complex sourcing (Merovich et al. 2007, Petty et al. 2010, Merriam et al. 2015b), especially in the near short-term. Therefore, the potential to maintain healthy aquatic communities via habitat improvement should be explored when considering holistic strategies for mitigation (Merovich et al. 2013). In the present study, it appeared that conductivity below 1,000 μS/cm paired with excellent habitat conditions could be conducive to supporting sufficient biological diversity to be considered healthy based on the current VSCI system (which mirrors the systems used by many other states); and even higher diversity is likely at values below 600 μs/cm. It should be noted that these results were observed in a region dominated by alkaline mine drainage as opposed to acid mine drainage. Similar analyses should be undertaken to determine if this key difference leads to different threshold values of conductivity in other regions such as central and northern West Virginia (Petty et al. 2010).

Regarding the common approaches to improve stream health, a likely stumbling block in the region is that of scale: TMDL efforts are watershed-scale goals at improving water quality within the entire system, while stream restoration and biological monitoring efforts are very site-specific. In reality, a focus on both water quality and stream habitat is needed at the watershed scale to conserve and restore healthy ecosystems as suggested by other recent work (Merovich et al. 2013). However, further research is required to determine the interdependence of watershed-scale variables such as water quality and hydrology, while small-scale in-situ studies must seek to optimize local biological response to restored habitat and food sources. An end goal for watershed management in Central Appalachian is to find an acceptable balance between conservation and/or restoration of valuable ecological systems and responsible development that can support the fragile economy and communities in this region.

Acknowledgements

Special thanks are given to the Appalachian Research Initiative for Environmental Science (ARIES) for funding this work; the Laboratory for Interdisciplinary Statistical Analysis (LISA) at Virginia Tech for assisting with statistical analysis; Travis Lowe and Tim Compton at Appalachian Technical Services, Inc. in Wise, Virginia for field support; and to several students at Virginia Tech who contributed countless hours of lab, field, and prep work including Vickie Nystrom, Sara Gotkurk, Rory Coffey, and Tyler Faulkner.

Supplemental Material

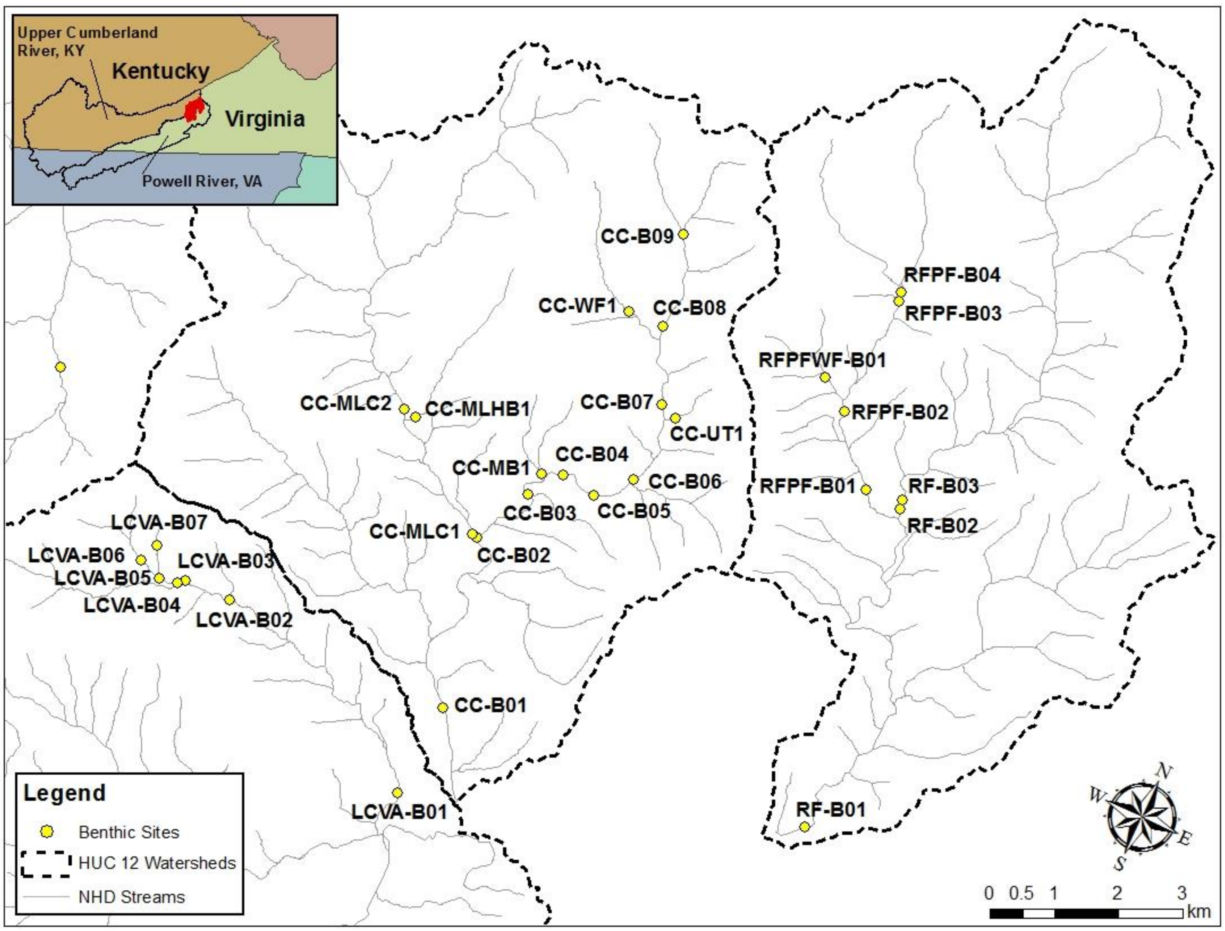

Figure 4-5. Virginia Site Locations and Site IDs

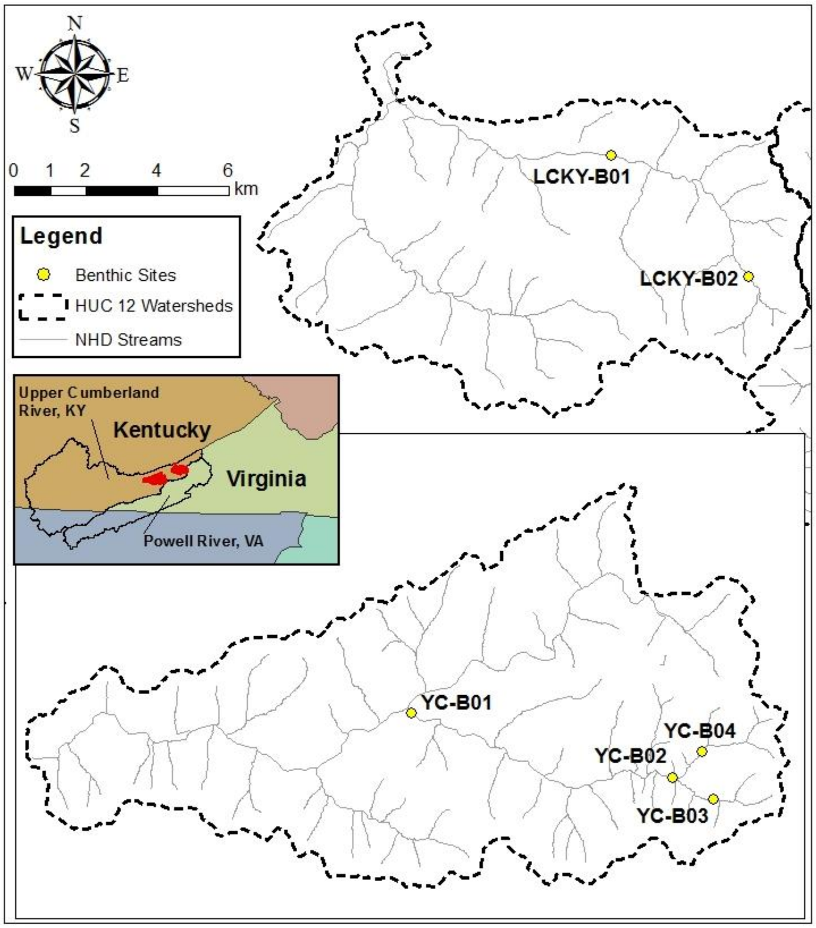

Figure 4-6. Kentucky Site Locations and Site IDs

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CHAPTER 5. BENTHIC MACROINVERTEBRATE RESPONSE TO CONCENTRATIONS OF SPECIFIC INORGANIC IONS

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Submitted: anticipated, July 2015
To: Ecological Engineering
Status: Under Committee Review

Abstract

In-stream conductivity is a primary focus of current efforts to protect and/or improve the unique ecology of headwater streams in the Central Appalachian region. Conductivity, which is a proxy for total dissolved solids, has been proposed as a measure of coal mining impacts and resultant stress on benthic macroinvertebrate populations. While the United States Environmental Protection Agency (USEPA) has developed a suggested benchmark of 300 μs/cm to preserve aquatic ecology, the specific ions responsible for macroinvertebrate stress and related impairment-triggering concentrations are unclear, which makes the design of effective remediation strategies difficult. In this study we examine biological monitoring data at 32 sites on five streams in the Virginia and Kentucky coalfields over two years to compare stream condition indices (SCI) to inorganic ion concentrations. Ion concentrations at the biological monitoring sites were determined using observational water quality data from nearby stream sites to calibrate a series of models: 1) the Spatial Tool for Analysis of River Systems (STARS) in ArcGIS and 2) the Spatial Stream Networks (SSN) package in R statistical programming. Cluster analysis and principal component analysis revealed three groupings of ions that were drivers of variability between biological sites: 1) Ca, K, Mg, Ni, and SO_4^{2-} related to surface mining discharges (37% variance); 2) Zn/Al and Si/P associated with general erosion and sewage sites respectively (20.8% variance); and 3) As, Na, Al, Cr, and Fe driving variance among both mining and non-mining groups (11.4%). Permutational MANOVA accounted for pseudoreplication within stream network systems and confirmed cluster analysis groups as statistically significant (R^2 = 0.45, pseudo-F statistic = 23.5). Correlations with ions associated with alkaline mine drainage (Ca, K, Mg, Ni, and SO_4^{2-}) were strongest in explaining negative impacts on Virginia Stream Condition Index (VSCI) scores, with most ions negatively correlated. The largest driver of benthic macroinvertebrate impairments (as defined by VSCI score) at these study sites appears to be ions associated with alkaline mine drainage (Ca, K, Mg, SO_4^{2-}, Na, and Ni), with untreated household waste-related ions (P, Si, Mn, Co, and Cr) contributing a secondary negative impact.

Introduction

The Central Appalachian region is a mountainous resource-rich area of the eastern United States that comprises the state of West Virginia, the eastern part of Kentucky, and the southwestern part of Virginia (ARC 2011a). This ecoregion is home to some the highest biodiversity densities found in the world (Bernhardt and Palmer 2011); however, Central Appalachia is also an economically distressed region which leans heavily on natural resource extraction industries to sustain its communities and tax revenues (Glasmeier and Farrigan 2003, ARC 2011b). The dichotomy of a resource-driven economy in a sensitive environment is one that has been historically difficult to balance and debates surrounding acceptable impacts remain heated.

Over the past two decades, there has been an increasing regulatory and public focus on mountain- top mining, which is an approach to extracting coal seams that may be economically unfeasible by any other method. This practice is accompanied by the creation of valley fills, where excess rock overburden from mined mountaintops often buries existing headwater streams, altering the geology and hydrology of the newly constructed fill (Holzman 2011). Following mine closure, the mountains themselves are generally returned to their approximate original contour, the hydrology and aquatic chemistry of affected headwater systems in adjacent valleys may be substantially altered. While the restoration of the physical hydrology is generally the focus of stream restoration engineers, changes in aquatic chemistry linked to the weathering of (previously undisturbed) fill material is of significant ecological concern given recent studies suggesting species sensitivity to ionic pollution (Freund and Petty 2007, Merovich and Petty 2007, Merovich et al. 2007, Pond et al. 2008, Merovich Jr. and Petty 2010, Pond 2010, Merriam et al. 2011, Coffey et al. 2013, Cormier and Suter 2013, Cormier et al. 2013a, Cormier et al. 2013b, Pond and North 2013, Suter and Cormier 2013).

At the federal level, a water quality benchmark for overall conductivity of 300 μs/cm has been suggested to protect sensitive aquatic invertebrate species from extirpation (USEPA 2011). This approach is problematic, however, as measures of conductivity comprise multiple constituent ions, some of which may be natural in origin or benign, while others may be contributed by a variety of pollutant sources, including surface mining. Difficulty in characterizing conductivity and its specific causal effects was the centerpiece of a recent legal battle in West Virginia: environmental groups sued the state environmental regulators to force the creation of conductivity Total Maximum Daily Load (TMDL) plans in order to meet the suggested benchmarks put forth by the USEPA. While the court acknowledged that specific ions that make up in-stream conductivity were likely responsible for poor aquatic ecology, they ultimately ruled in favor of the state, citing that the exact constituent ions triggering macroinvertebrate stress and threshold concentrations triggering impairment were unknown, precluding TMDL development (DiCosmo 2015). Numerous recent studies in the region report that contributions to conductivity in the Central Appalachian region include residential areas, untreated household waste (UHW), sediment from logging practices, as well as a variety of sources from both active and legacy coal mining sites on the surface and underground (Farag et al. 1998, Ibeanusi et al. 2003, Cravotta III 2008, Diehl et al. 2012, Miguel-Chinchilla et al. 2014). While each of these sources can raise in-stream conductivity, observed combinations of ions may be largely source-specific (Cook et al. 2015).

Considerable effort has been made to examine conductivity production, prevention, and effects on aquatic organisms. These efforts include studies of discharges from gob piles (Ibeanusi et al. 2003), underground mines of varying geological make-up (Cravotta III 2008), sediment ponds (Merricks et al. 2007, Miguel-Chinchilla et al. 2014), and constructed valley fills (Merricks et al. 2007, Evans et al. 2014). Meanwhile, additional work examined ionic pollution related to leachate from valley fills (Agouridis et al. 2012, Simon et al. 2012) and suggested methods by which valley fill contributions to conductivity might be reduced through strategic fill placement. Some lab studies examining the biological effects of conductivity (whole-effluent toxicity testing of conductivity on standard organisms) demonstrate that sulfate-dominated, high conductivity waters are toxic to both standard test organisms (Kennedy et al. 2005, Echols et al. 2010) as well as a more sensitive mayfly species (Kennedy et al. 2004, Echols et al. 2010) at levels above 1000 μs/cm; however, the results of these efforts often do not match field-based observations of general conductivity (Yeager-Armstead et al. 2013), where the sensitivity of aquatic organisms to conductivity appears more variable. In addition, most of the previous field work focuses on overall measures of conductivity and does link aquatic organism health to specific ion concentrations.

By linking inorganic ions and specific pollution sources, more appropriate benchmark levels might be set that target particular sources of macroinvertebrate stressors, allowing for more effective prediction and mitigation strategies, and preventative best management practices. The work presented here extends a previous study by the authors that sought to identify inorganic ion contributions from different pollutant sources in five watersheds with several known sources of water pollution (Cook et al. 2015). The present effort uses these observed inorganic ion concentrations to geo-statistically model inorganic ion concentrations at biological monitoring sites, which allows for a statistical analysis of ion concentrations and their effects on Virginia Stream Condition Index (VSCI) scores. Through linking benthic observations with site specific conductivity profiles, we aim to identify primary ion constituents responsible for local impacts on VSCI scores. With understanding of the ions that are driving negative VSCI impacts, we can also examine the sources of these ions based on the results of our previous study (Cook et al. 2015), which showed links between specific pollution sources and increases in particular inorganic ions.

Methodology

Study Area

The five study watersheds in Virginia (Figure 5-1) and Kentucky (Figure 5-2) are in the same ecoregion and are geologically and hydrologically similar due to their geographic proximity. All streams are main stem streams in 12-digit hydrologic unit code (HUC) watersheds; three are located in the Powell River Basin in Wise County, Virginia (Callahan Creek, Roaring Fork, and Looney Creek-VA in the Pigeon Creek watershed), while the other two lie within the Cumberland River Basin in Harlan County, Kentucky (Yocum Creek in the Lower Clover Fork watershed and Looney Creek-KY in the Looney Creek Poor Fork watershed). These watersheds are within the Cumberland Plateau physiographic region, and are dominated by Pennsylvanian-age sandstones, shales, and coal formations.

Primary upland pollution sources vary across watersheds and may include untreated household waste (UHW), surface mining operations (SMO), a combination of UHW and SMO, legacy underground mining operations (UMO), or minimal disturbance (reference condition). The watershed cluster was specifically targeted to represent distinct patterns, i.e. Looney Creek-KY represents the reference conditions, Yocum Creek represents UHW-only sites, Looney Creek-VA is a mining-disturbed watershed with no UHW present, and both Callahan Creek and Roaring Fork represent sites that are either mining only sites in the headwaters or a mix of UHW and mining further downstream.

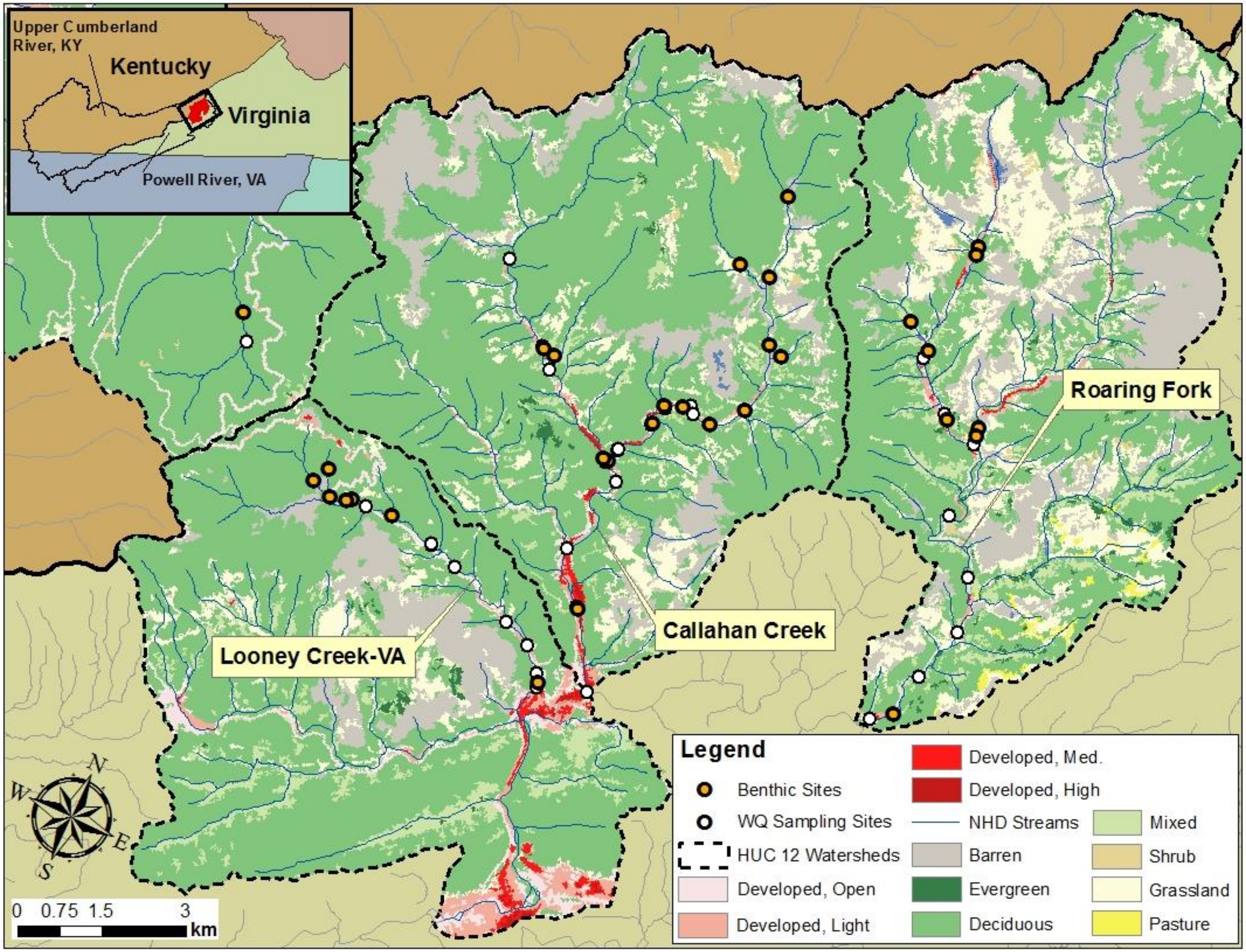

Figure 5-1. Virginia Water Quality and Biomonitoring Sample Sites with Land Use Raster Data

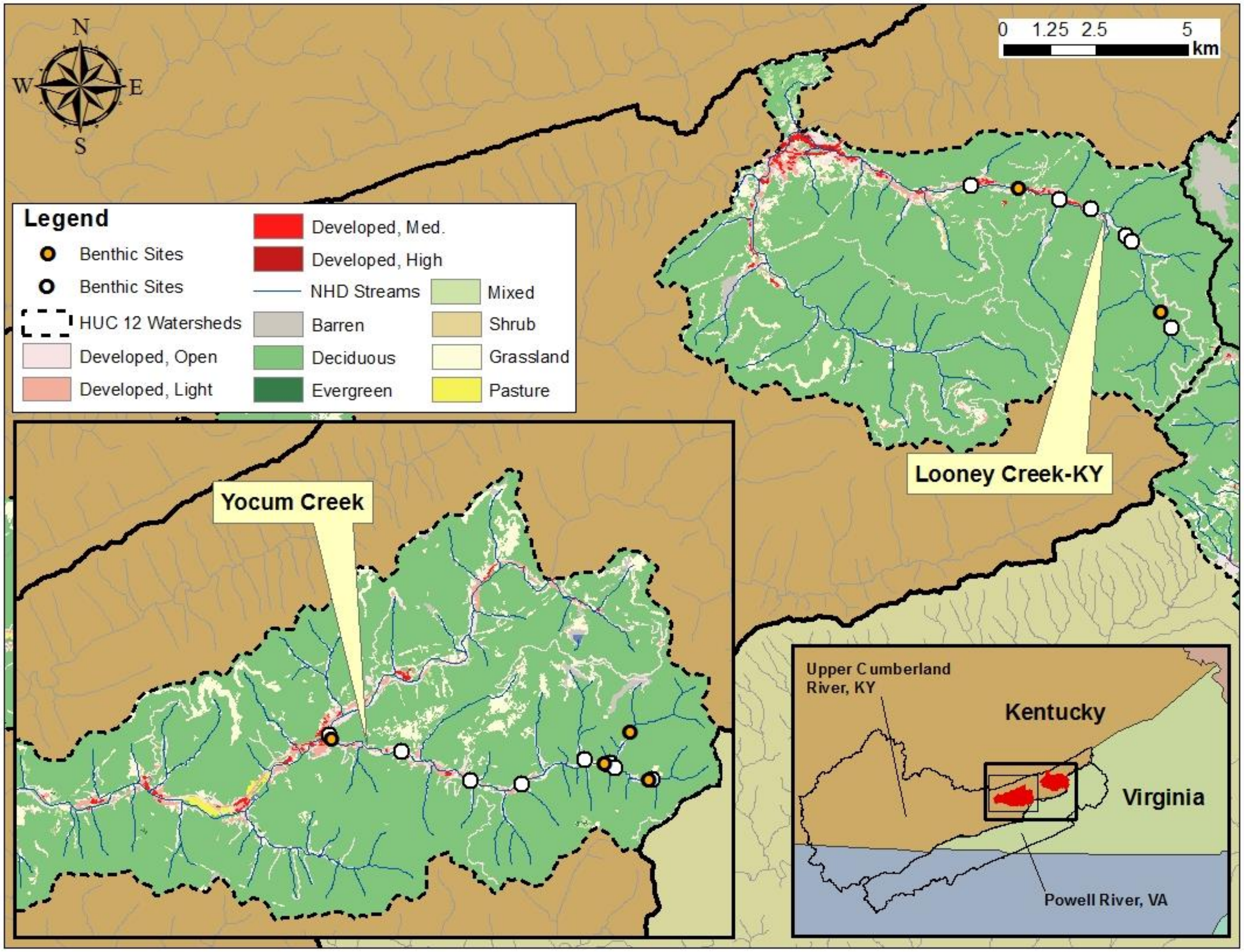

Figure 5-2. Kentucky Water Quality and Biomonitoring Sites with Land Use Raster Data

Observed Data

Collected field data in this study falls into one of two categories: 1) data collected at 45 sites during a two-year water quality monitoring campaign reported previously (Cook et al., 2015); and 2) data collected at 36 separate sites during a parallel biological monitoring campaign. Site coverage in the study watersheds was distributed based on pollutant source locations to maximize variability in site types; Looney Creek-KY (6 WQ sites, 2 biomonitoring sites), Yocum Creek (8 WQ sites, 4 biomonitoring sites), Looney Creek-VA (8 WQ sites, 7 biomonitoring sites), Callahan Creek (14 WQ sites, 15 biomonitoring sites), and Roaring Fork (9 WQ sites, 8 biomonitoring sites) each represented unique conditions that this campaign was designed to capture. Data collected during the water quality campaign consisted of in-stream measurements of dissolved oxygen (DO), temperature, pH, conductivity, and alkalinity (year 2 only) on a monthly basis using a YSI Quattro Pro Plus (YSI, Yellow Spring, OH; USA). The YSI Quattro Pro Plus was calibrated as needed after pre-sampling checks of instrument performance. Methods for calibration were single-point DO calibration in water-saturated air, triple point pH calibration, and single-point conductivity calibration using a certified conductivity standard.

Samples for subsequent laboratory analysis of inorganic ions were collected in sterilized, acid-washed 250 mL polypropylene bottles. Bottled samples were transported on ice to the Biological Systems Engineering Water Quality Laboratory in Blacksburg, VA. Promptly after return, 10 mL of the bottled sample was acidified with nitric acid to 2% concentration for ICP-MS analysis. In cases of high turbidity or particle loading, samples were syringe filtered using a 0.45 Whatman PES filter prior to analysis to protect the instrument from damage. Instrument detection limits and maximum recoverable limits of specific ions is available in (Cook et al. 2015). Alkalinity was analyzed in the lab using a HACH Alkalinity Test Kit (Model AL-DT) on an additional 100 mL subsample. Because the geology in the region is dominated by carbonate formations and pH values were consistently between 7-9, alkalinity could be used to approximate bicarbonate (HCO_3^-). For the purposes of this study, observed values for specific ions were averaged over the season during which biological monitoring occurred (fall = average of August, September, and October data; spring = average of March, April, and May data). By using these time periods, ion concentration values were more directly tied to the condition of organisms observed during those months, which comprise the recommended sampling periods under Virginia state guidelines (VADEQ 2010).

At biological monitoring sites, certified benthic macroinvertebrate assemblage data was collected along with rapid bioassessment protocol (RBP) data for fall and spring sampling seasons from fall 2012 to spring 2014 (n=4 observations per site). Some of the data used in this study was gathered from required permit compliance reports for several coal mine operators in the region, while others were contracted specifically for this study. All sampling and reporting was completed by the same certified environmental technicians with accompanying QA/QC procedures required by state and federal reporting guidelines. Collection of benthic assemblages was via the single habitat method, i.e. disturbance of the stream bed in a riffle area of 0.25 m^2 in front of a 500 μm mesh kicknet (Barbour et al. 1999, VADEQ 2010). The process was repeated eight times to yield a sample area of 2 m^2. Samples were stored in individual containers of 95% ethyl alcohol, labeled and returned to the nearby laboratory for identification by certified biologists. Collected specimens were subsampled in accordance with standards set by the

Virginia Department of Environmental Quality and generally resulted in 300 (±20%) individuals (VADEQ 2010). The Ecological Data Application System (EDAS), created by Tetra Tech, Inc. (www.tetratech.com, Pasadena, CA, USA), was used to rarify family-level identification of species to 110 individuals and to generate a Virginia Stream Condition Index (VSCI) score for each site observation (Burton and Gerritsen 2003). This database was created specifically for VADEQ and is used by state agencies for biological monitoring to support impairment identification in keeping with the state's TMDL program. Per standard practice, RBP data collection includes the assessment of habitat metrics and water quality (Barbour et al. 1999); however, for the purposes of this study, only the water quality data was needed to support model formulation. Water quality parameters (DO, pH, temperature, and conductivity) at the biologic monitoring sites were measured using an YSI Pro Plus multimeter (YSI, Yellow Spring, OH; USA) and were measured at the time and location of species collection. Ion concentrations were not directly measured at biological monitoring sites, thus in-stream observation sites were used as a training data set to model in-stream ions at biological monitoring sites.

Modeled Data

A general illustration of the modelling process is provided in Figure 5-3. In brief, inorganic ion concentration data was predicted via the Spatial Tools for Analysis of River Systems (STARS) (Hoef et al. 2014) tool in conjunction with the Spatial Stream Networks package in R (Peterson and Hoef 2014) based on the data collected during the two-year water quality monitoring effort. The first step of this process is to build a topological network from the stream system, observation points, and desired prediction points. For the purposes of this study, the stream network represented an error-free version of the National Hydrology Dataset (NHD), while observation points were the water quality sampling points. Prediction points were the biological monitoring points. From this point forward the terms prediction points/sites refers to these biological monitoring sites, and observation points/sites represents water quality sampling points. The STARS toolbox labels all nodes in the topological network including observation and prediction sites, and also logs directional data from upstream nodes to downstream nodes, allowing for statistical modelling along the network considering flow-dependence (tail-up), flow-independence (tail-down), or Euclidean distance approximations.

Once the network object is created, it can be imported into the SSN package in R, where modelling, validation, and selection can occur (second step). Field data (ion concentrations at observed sites) were included in the network object and were scaled, which allowed the use of a Gaussian distribution assumption in the modelling function in SSN. This process was completed for each observed season: fall 2012, spring 2013, fall 2013, and spring 2014. Model development for ion concentrations involved a two-part iterative testing procedure: autocovariance function selection (determines spatial-specific relationship among sites along the stream network) and predictive formula selection (determines relationship to explanatory variables).

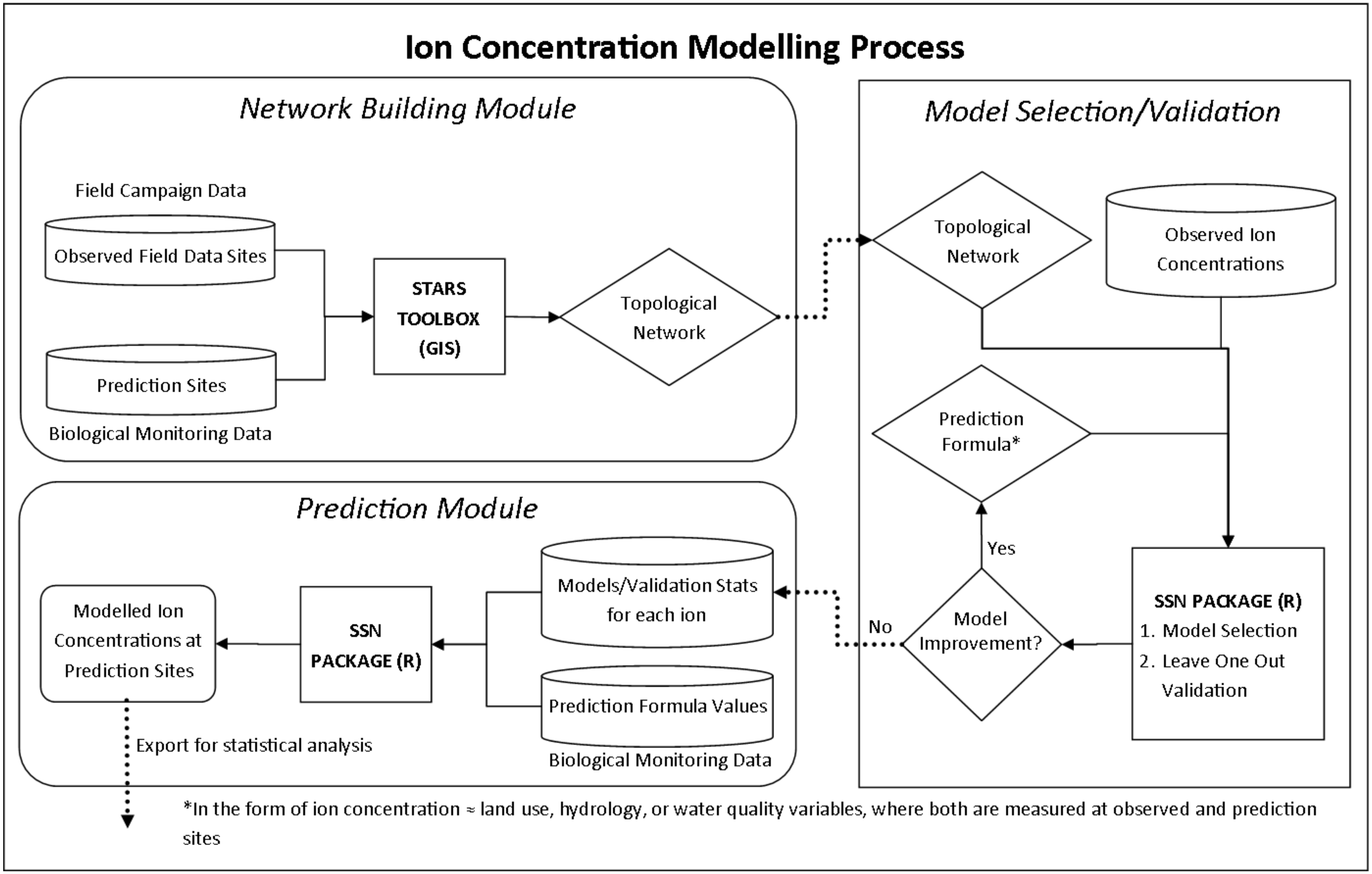

Figure 5-3. Process Diagram for ion concentration modelling at biological monitoring sites

Within the autocovariance functions, three spatial modelling options are available: flow-dependent (5 models), flow-independent (5 models), and Euclidean distance (4 models) (Peterson and Hoef 2010). In addition to three model types, the SSN package allows the combination of two or three model types, which has been shown to improve (lower) model root mean square prediction error (RMSPE) (Peterson and Hoef 2010). To test for the best combination of autocovariance functions, iterative code was used for each ion in the observed datasets to find the optimal combination of functions for modelling (out of 179 total possible selections). This combinatorial approach allowed for the likelihood that all ions did not persist in the stream column identically and that overland influence (Euclidean distance) of ions was not identical within model development. Again, each seasonal dataset was treated separately, which allowed for these mechanisms to be season-specific within the modelling paradigm.

Unlike autocovariance function selection, the predictive formula was varied manually. Testing included the use of observed water quality values (DO, pH, temperature, and conductivity), land use information (based on National Land Cover Dataset rasters), and spatial characteristics (distance from watershed outlet, subwatershed area). The iterative code described above was run using six different formulas to compare resultant RMSPE (Chai and Draxler 2014) of the models and decide upon the best predictive formula. Because of the heavy linear correlation between spatial characteristics, land use, and ion concentrations, the model failed to find solutions when using these explanatory variables, thus further exploration was limited to water quality characteristics. When variables are strongly linearly dependent, the result is a matrix that is not positive-definite, which in return causes the failure of the matrix functions within the SSN package. Four trial predictive formulas isolating land use, spatial characteristics, and the combination of either with water quality variables as a cause of model failure led to the focus on water quality variables. The remaining two trials confirmed that the combination of all four (conductivity, pH, DO, temperature) returned the best possible results (One run with all water quality parameters, followed by a run removing a single variable which resulted in an increase in RMSPE). Once the optimal formula was found and the autocovariance models for each ion in all four seasonal datasets were selected, the end result was a reference table of ion name, autocovariance model selection, and RMSPE for each model. Using this reference table and the prediction points in the network object, the prediction algorithm in the SSN package was run iteratively to model ion concentrations at the prediction sites, creating a dataset with benthic macroinvertebrate observations and water quality data at each time and specific location.

Statistical Analysis

Following completion of the modelled dataset of specific ion concentrations for the prediction sites, a simple response variable and multivariate prediction matrix scenario was available for multivariate statistical analysis. Using the ion concentration matrix at the prediction sites, Ward’s hierarchical method of cluster analysis (CA) was used to determine if distinct groups existed within the sites in terms of ion concentrations (Ward 1963). This agglomerative clustering method begins with all sites as individual groups and combines groups to minimize within-group variance. Validation of these clusters was completed using Classification and Regression Tree (CART) analysis (Fabricius 2000). Because several sites are located within the same watershed/stream system, permutational MANOVA was used to test groups versus stream location to ensure minimal pseudoreplication effects (Anderson 2001). This process confirmed that group assignments were due to ion concentrations rather than location (i.e. influence of upstream sites). Once these groups were defined and validated, principal component analysis (PCA) was used to determine variables driving relationships in the data. PCA is an ordination technique used to reduce multivariate data to a smaller number of dimensions (in this case, 18 ions on 2 or 3 axes). It creates principal components (PCs) equal in number to the variables, and a scree plot of the eigenvalues of these PCs can be used to determine which PCs are significant (Legendre and Legendre 2012). Once the significant PCs are determined, they can be plotted in reduced data space (e.g. a biplot in the case of two most significant PCs). Additionally, prediction sites can be colored to show their group membership from cluster analysis, which allows simple visualization of the ion concentrations driving differences between groups, group membership itself, and the variance within groups.

Results

Selected models to predict specific ion concentrations at the biological monitoring sites are provided in Table 1. Smaller RMSPE values indicate a highly accurate model. Equations for the different model types can be found in a precursor study to the development of the STARS package (Peterson and Hoef 2010). In general, from Table 5-1 it is clear that flow-connectedness (tail-up models) and overland effects (Euclidean distance) are likely the main drivers of in-stream ion concentrations based on the model selections shown in Table 5-1. Most pollutant sources (mining, UHW) are located in the headwaters of these areas, thus ion concentrations are likely to diminish in a unidirectional fashion. Meanwhile, Euclidean location within the watershed likely also plays a role in terms of general site proximity to pollutant sources (e.g. mining in headwater areas may vary directionally along ridgelines).

Exploratory CA identified seasonally consistent groupings across each individual seasonal dataset (meaning the same groupings recurred regardless of season), with the data forming five statistically distinct groups in each season (R^2 = 0.66, 0.65, 0.62, 0.65; Pseudo-F = 11.7, 12.2, 11.0, 11.1; p = 0.001) regardless of stream location (based on PERMANOVA results). Because groups with similar characteristic ion suites were identified across all seasons, these groups were averaged into five overall groups (Table 5-2). In terms of overall trends, Group 1 sites were characterized by low concentrations of mining-related ions, but were high in P with elevated Na; these sites were generally located in areas with UHW discharges. Group 3 contained most of the reference sites as well as sites on mining permits located in largely undisturbed tributaries; these sites showed the lowest concentrations across ions associated with UHW (Na, P), and moderate to low levels of ions associated with surface mining (Ca, K, Mg, Ni, Se, SO_4^{2-}). Group 2 represented a mixture of elevation in UHW ions and surface mining-associated ions, representing most sites downstream of both UHW and surface mining in Callahan Creek. Groups 4 and 5 were sites in headwater surface mining stream sections and showed the highest levels of mining-related ions (Ca, K, Mg, Ni, Se, SO_4^{2-}).

Table 5-1. Seasonal model selection/validation results for ion concentrations

Ion	Seasonal Models				Seasonal RMSPE			
Ion	***F12***	***S13***	***F13***	***S14***	***F12***	***S13***	***F13***	***S14***
Zn	E.TU + E.TD + G.E	M.TU	LS.TU + LS.TD + G.E	LS.TU + LS.TD + EX.E	0.539	1.103	1.106	1.075
As	EX.TU + S.TU + C.E	S.TU + LS.TD + C.E	S.TU + E.TD + G.E	C.E	0.724	0.734	0.381	0.987
Se	N/A	E.TU + G.E	LS.TU + E.TD + C.E	SP.TU + E.TD + C.E	N/A	0.221	0.327	0.458
Na	LS.TU + S.TD + C.E	E.TU + S.TD + G.E	M.TD + G.E	LS.TU + E.TD	0.805	0.632	0.705	0.733
Mg	S.TU + M.TD + C.E	E.TU + E.TD + C.E	LS.TU + M.TD + C.E	E.TU + S.TD + C.E	0.491	0.338	0.288	0.211
Al	LS.TD + S.E	LS.TU + M.TD + G.E	S.TU + E.TD + C.E	E.TU + EX.TD	0.889	0.816	0.708	0.685
Si	LS.TU + EX.TD + G.E	S.TU + G.E	E.TU + E.TD + G.E	LS.TU + LS.TD + S.E	0.672	0.424	0.538	0.290
P	M.TU + E.TD + S.E	EX.E	LS.TD + C.E	EX.TU + LS.TD + G.E	1.055	1.078	1.097	1.027
SO_4^{2-}	EX.TU + LS.TD + C.E	EX.TU + LS.TD + G.E	LS.TU + LS.TD + G.E	E.TD + C.E	0.169	0.189	0.228	0.185
Cl	LS.TU + LS.TD	EX.TU + E.TD	EX.TU + S.TD + S.E	LS.TU + E.TD + G.E	0.823	0.662	0.671	0.388
K	LS.TU + E.TD + G.E	E.TU + LS.TD	E.TU + S.TD	E.TU + E.TD	0.284	0.195	0.201	0.244
Ca	EX.TU + E.TD + G.E	LS.TU + M.TD + C.E	E.TU + EX.TD + C.E	M.TU + E.TD + G.E	0.559	0.355	0.277	0.203
Cr	LS.TU + LS.TD	E.TU + S.TD	LS.TU + LS.TD + S.E	M.TU + LS.TD	1.034	1.038	1.037	0.999
Fe	EX.TU + LS.TD + G.E	LS.TU + EX.TD + EX.E	G.E	EX.TD + G.E	1.044	0.943	0.804	0.638
Mn	E.TU + LS.TD	LS.TD + G.E	M.TU + LS.TD + S.E	E.TD + G.E	0.591	0.566	0.506	0.372
Co	LS.TU + LS.TD + S.E	E.TU + LS.TD + G.E	LS.TU + M.TD + C.E	LS.TU + LS.TD + G.E	0.730	0.722	0.651	0.983
Ni	E.TU + E.TD	LS.TU + LS.TD	S.TU + M.TD	E.TU + S.TD + EX.E	0.730	0.431	0.324	0.347
HCO_3	N/A	N/A	LS.TU + LS.TD + S.E	LS.TU + LS.TD + G.E	N/A	N/A	0.447	0.490

*N/A values indicate either no data or error-prone data was available for model development

Model Codes

Tail-up: Epanech (E.TU), Exponential (EX.TU), Linear Sill (LS.TU), Mariah (M.TU), Spherical (S.TU)

Tail-Down: Epanech (E.TD), Exponential (EX.TD), Linear Sill (LS.TD), Mariah (M.TD), Spherical (S.TD)

Euclidean: Cauchy (C.E), Exponential (EX.E), Gaussian (G.E), Spherical (S.E)

The results from PCA (Table 5-3) identify the same ions as significant across all seasons. Ions explained group membership and location in data space well, with between 70-85% of variance explained by the first three PCs in all seasons. The ions associated with alkaline mine drainage (Ca, K, Mg, SO_4^{2-}) and the trace metal Ni consistently explained the most variance (> 40%; PC1) between sites. PC2 and PC3 were represented by ions associated with sewage discharges (P, Na) and other soil elements and trace metals (Al, Co, Cr, Fe, HCO_3^-, Mn, Se, Si, Zn), which is in keeping with previous work (Cook et al. 2015), and further supports the model results as acceptable.

Table 5-2. Ion concentrations of cluster analysis-identified groups averaged over all seasons

	Group (n)				
Ion§	**1 (14)**	**2 (40)**	**3 (23)**	**4 (25)**	**5 (18)**
Al	54.8	42.6	51.8	30.8	29.5
As	0.02	0.02	0.06	0.05	0.10
Ca	21165	42484	60735	67711	100245
Cl	3526	5422	5046	0.21	1430
Co	0.07	0.11	0.29	1430	0.53
Cr	0.53	0.57	0.41	0.55	0.60
Fe	65.0	96.7	128.7	84.9	132.8
HCO_3^-	1810	1289	1065	608	1377
K	2424	2424	4000	5002	6122
Mg	6271	18699	26138	30715	49711
Mn	38.8	28.1	45.8	51.2	92.9
Na	61807	62365	43678	69741	88447
Ni	0.31	0.66	1.20	1.39	1.91
P	4.7	3.6	2.5	2.9	2.8
Se	0.64	0.90	1.13	1.77	2.08
Si	2434	2436	2190	2321	2373
SO_4^{2-}	54730	174215	233335	302050	491895
Zn	6.7	3.3	5.7	7.5	4.9

§All concentrations in ppb

Given identical results across seasons, the modelled ion datasets for fall and spring were combined into one dataset for analytical comparison to biological scores as mentioned above. CA and PCA results for this combined dataset are shown in Table 5-4. The significant PCs are consistent with the results from the seasonal analysis, lending credibility to the decision to combine the data. PC1 is once again dominated by ions related to alkaline mine drainage accompanied by the trace metal nickel, while PC2 and PC are associated with UHW-related ions (P, Na), earth metals, and potential additional trace metals.

Table 5-3. PCA results of seasonal ion concentration data

Season	**Fall 2012**			**Spring 2013**			**Fall 2013**			**Spring 2014**		
PC	*PC1*	*PC2*	*PC3*	*PC1*	*PC2*	*PC3*	*PC1*	*PC2*	*PC3*	*PC1*	*PC2*	*PC3*
Al	-0.19	**-0.30**	**0.38**	0.16	-0.27	**0.46**	0.21	-0.04	**-0.53**	0.08	0.06	**0.40**
As	0.01	0.05	-0.19	**-0.32**	0.10	0.17	**-0.31**	-0.05	-0.04	0.23	-0.16	**-0.36**
Ca	**0.37**	-0.02	-0.12	**-0.36**	-0.04	-0.13	**-0.34**	-0.08	0.07	**0.32**	-0.11	-0.09
Cl	-0.18	-0.18	-0.26	0.28	-0.12	-0.23	0.27	0.03	0.16	0.01	**0.43**	0.25
Co	0.27	0.01	**0.39**	-0.18	**-0.40**	0.15	-0.18	-0.03	**-0.50**	**0.33**	0.06	0.09
Cr	-0.11	**0.46**	0.07	-0.11	**0.30**	0.04	-0.16	**0.41**	0.00	0.03	**-0.38**	**0.33**
Fe	0.29	-0.33	-0.12	-0.13	**-0.45**	0.07	-0.10	0.14	**-0.40**	0.25	0.08	**0.38**
HCO_3	NA	NA	NA	NA	NA	NA	0.01	**0.32**	**-0.37**	-0.06	**-0.39**	0.29
K	**0.31**	0.27	-0.11	**-0.37**	0.04	0.06	**-0.34**	-0.08	0.07	0.28	-0.19	-0.25
Mg	**0.35**	0.07	-0.02	**-0.35**	-0.01	-0.16	**-0.33**	-0.08	0.08	**0.33**	-0.05	-0.04
Mn	0.24	-0.03	**0.42**	-0.16	**-0.31**	-0.26	-0.17	-0.29	0.00	0.22	-0.11	0.28
Na	0.06	**0.47**	-0.02	-0.16	-0.08	**-0.30**	-0.25	**0.31**	0.01	0.06	**-0.44**	0.22
Ni	**0.35**	-0.04	-0.06	**-0.35**	0.00	0.25	**-0.31**	-0.21	-0.05	0.28	-0.09	-0.28
P	-0.23	**0.31**	0.21	-0.02	0.08	**-0.55**	-0.10	**0.44**	-0.10	-0.23	-0.28	-0.19
Se	NA	NA	NA	-0.09	0.26	0.15	-0.17	-0.21	-0.13	**0.32**	0.11	0.01
Si	-0.23	0.24	0.23	-0.17	0.23	0.25	-0.14	**0.33**	0.21	-0.21	**-0.31**	-0.02
SO_4^{2-}	**0.32**	0.28	0.01	**-0.36**	-0.10	-0.12	**-0.34**	-0.02	-0.01	**0.33**	-0.09	-0.01
Zn	-0.13	0.14	-0.53	0.07	**-0.46**	0.04	0.05	**-0.34**	-0.24	0.19	0.14	0.00
Var. Ex. (%)	41.4	21.6	12.9	40.9	21.1	10.3	46.3	20.6	10.5	47.5	21.9	13.7
Eigenvalue	6.6	3.5	2.1	6.9	3.6	1.7	7.9	3.5	1.8	8.5	3.9	2.5

These results show a strong relationship across all seasons between surface mining disturbance and elevated in-stream ion concentrations of Ca, K, Mg, Ni and SO_4^{2-}. These elevated ions, along with observed in-stream pH levels (between 7-9) suggest alkaline mine drainage which is consistent with the local carbonate geology (Bernhardt et al. 2012). Similar to previous analysis of observed data in the study watersheds (Cook et al. 2015), predicted ions consistent with UHW (P particularly) were significant in CA/PCA as well, along with those possibly related to overland erosion (Zn, Fe, Al). Figure 5-4 provides the three-dimensional plot of the combined cluster analysis and principal component analysis results, which allows visualization of these observed trends in the data.

Table 5-4. PCA results of combined seasonal ion concentration data

Ion	PC1	PC2	PC3
Al	-0.13	**0.32**	**0.39**
As	0.16	0.24	**0.33**
Ca	**0.39**	0.00	-0.15
Cl	-0.21	0.25	-0.05
Co	0.27	0.28	0.25
Cr	0.06	-0.26	**0.53**
Fe	0.17	**0.30**	**0.33**
K	**0.38**	-0.14	-0.07
Mg	**0.38**	0.01	-0.12
Mn	0.24	0.11	-0.04
Na	0.18	-0.29	**0.31**
Ni	**0.35**	0.00	-0.19
P	-0.09	**-0.38**	0.23
Si	0.00	**-0.38**	0.23
$SO4^{2-}$	**0.39**	-0.05	0.00
Zn	0.01	**0.35**	0.11
Variance	37.3%	20.8%	11.4%
Eigenvalue	5.97	3.33	1.83

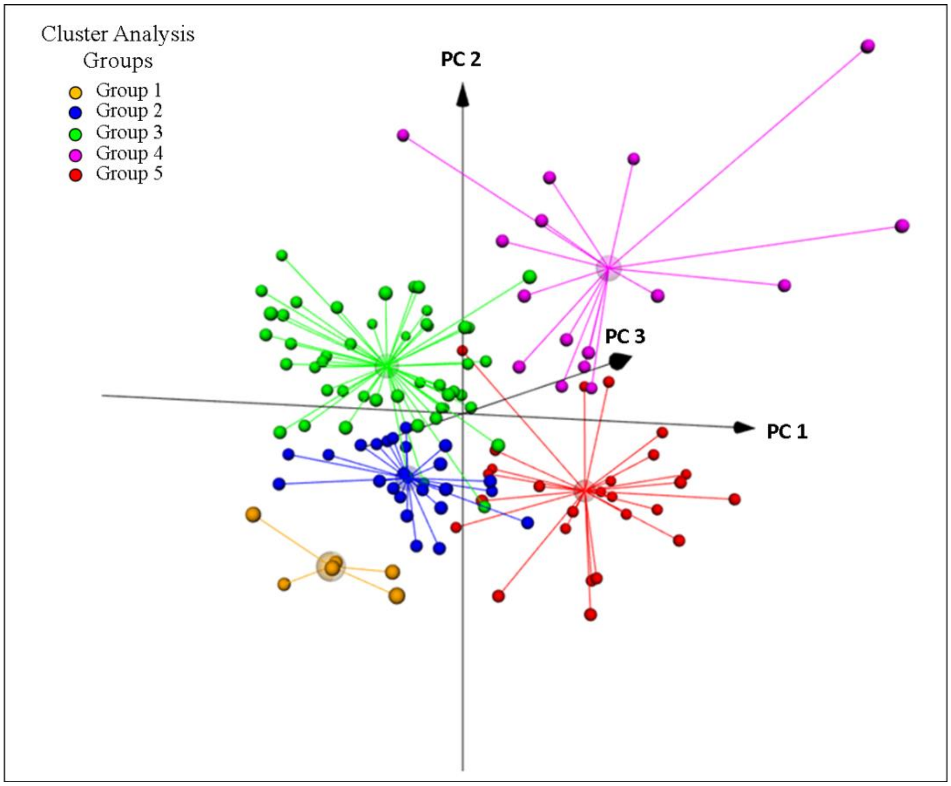

Figure 5-4. 3D PCA plot of ion concentrations with cluster analysis groupings

As illustrated in Figure 5-5, the general location of passing VSCI scores in the data space are consistent with lower alkaline mine drainage-related ions (Ca, K, Mg, Ni, SO_4^{2-}), though it is worth noting that addition of sewage related ions (P, Si) is associated with lower density of passing VSCI scores. Passing sites are primarily in the upper left-hand quadrant of the biplot, consistent with lower alkaline mine drainage-associated ions as well as lower P and Si. Group 3 (green) appears to be the best conditions for successful biological attainment in the study streams. This result is consistent with general expectations given that sites in the reference watershed and on un-mined tributaries generally fall into this group. Group 1 (yellow) is consistent with reduced ions from surface mining as are Group 2 (blue) and Group 3, but are the most polluted with sewage-related ions of the groups (P, Na). Sites from the UHW-driven watershed generally fall into this group. Figure 5-6 shows the correlation matrix of VSCI as well as predicted ion concentrations. The inter-ion correlations suggest that the strongest correlations occur between PC1 ions (Ca, K, Mg, Ni, SO_4^{2-}). For ions related to PC2, P was only positively correlated with Cr, Na, and Si. In terms of VSCI score, the largest negative correlations were found related to the PC1 ions listed above, but also with most other inorganic ions. While some ions exhibited positive correlations with VSCI, it is unlikely that their increase would yield better VSCI scores, but rather higher levels of these ions are, for this dataset, indicative of a lack of increase in the ions that most affect VSCI score negatively.

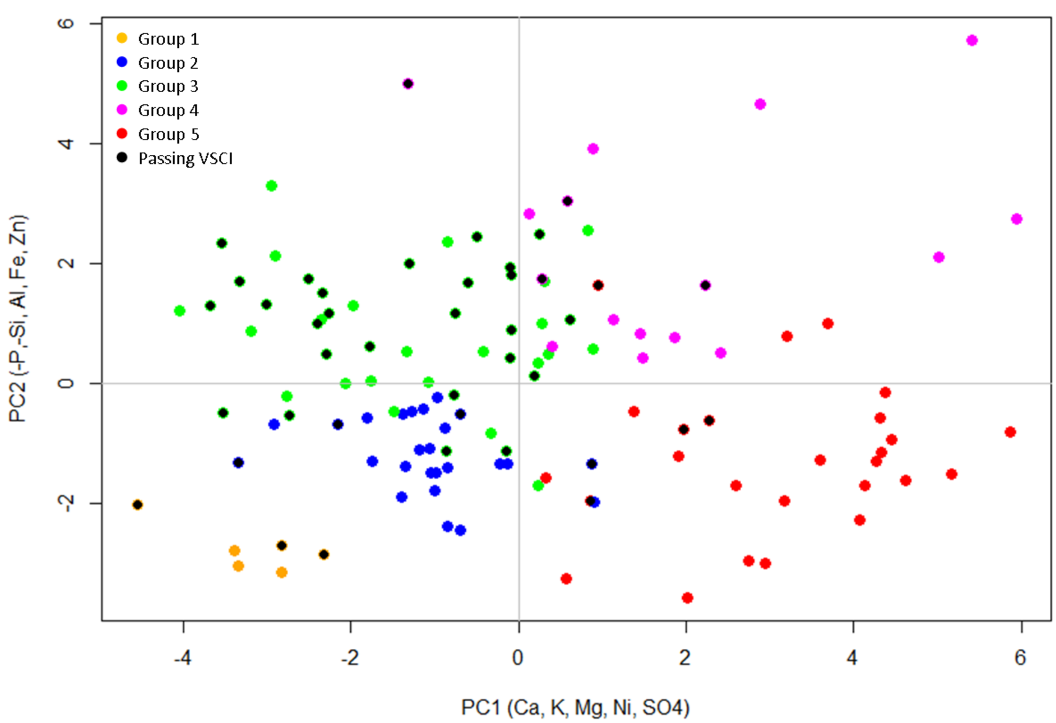

Figure 5-5. PC1 vs. PC2 with passing VSCI observations

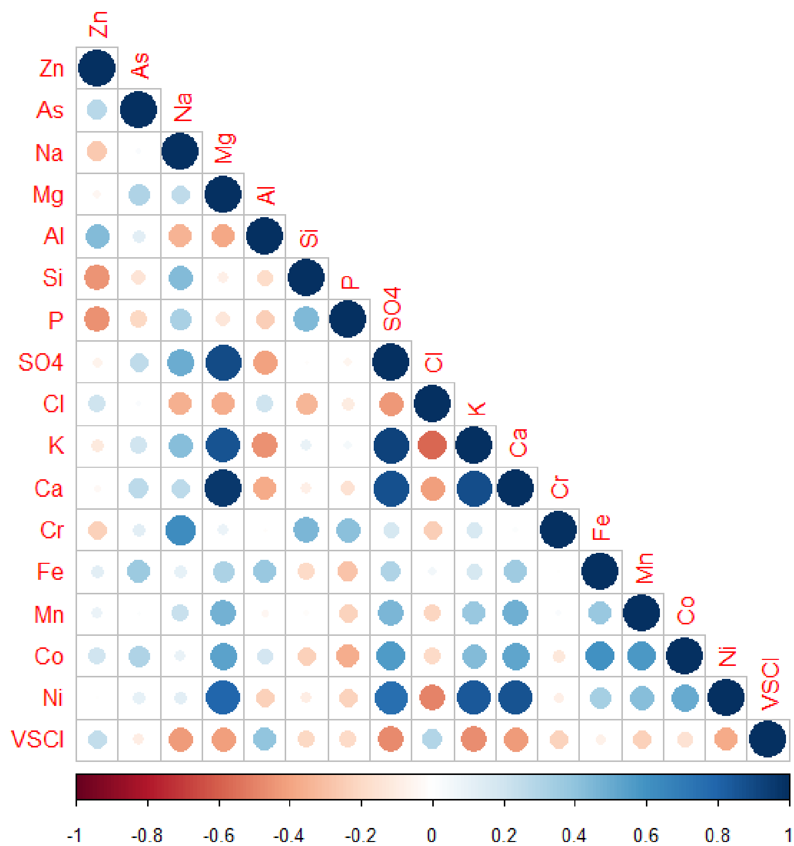

Figure 5-6. Correlation matrix of ions and VSCI scores

Discussion

Overall, this study has shown that geostatistical modeling that takes advantage of inherent autocovariance in stream structures can be a useful tool to determine reasonable ion predictions for unmonitored sites further upstream, providing larger coverage for predictions based on fewer observed locations. Justification for using these models is strongly defended in a recent paper citing many examples where this method could be used for modeling stream temperature, conductivity, species presence or absence, and habitat changes. The study showed that STARS and SSN would be an improvement over previously used methods such as MANOVA (Isaak et al. 2014). Because of the relatively recent development of this tool, only one other study has applied this method; this study used STARS and SSN to model climate change, upland wildfires, and changes in stream temperature (Isaak et al. 2010).

More specifically, our results indicate that the largest driver of benthic macroinvertebrate impairments (as defined by VSCI score) at these study sites appears to be ions associated with alkaline mine drainage (Ca, K, Mg, SO_4^{2-}, Na, and Ni), with UHW-related ions (P, Si, Mn, Co, Cr) contributing a secondary negative impact. Alkaline mine drainage, like acid mine drainage, is driven by sulfuric acid generated during the weathering of coal seam-related geology and results in dissolved inorganic salts in drainage waters; in the case of alkaline mine drainage, however, the acid is quickly neutralized by the local carbonate-rich geology. Thus, alkaline mine drainage is often high in both sulfate and carbonate species, which is consistent with the results found here and other studies on mining-related discharges (Freund and Petty 2007, Cravotta III 2008, Lindberg et al. 2011, Bernhardt et al. 2012, Cormier et al. 2013c, Cook et al. 2015). These findings are supported by Figure 5, where the strongest negative correlations with VSCI score are Ca, K, Mg, Na, Ni, and SO_4^{2-} (i.e. PC1). The likely form of these compounds is either as inorganic salts of $SO4^{2-}$ origin or trace metals (Ni) potentially also in solution with SO_4^{2-}. It should be noted that Se and HCO_3^- could not be included in this analysis because of inconsistent data coverage, but a previous study and seasonal analysis included here do indicate that these ions co-vary with alkaline drainage-related ions (Cook et al. 2015).

Further steps are needed to confirm relationships between specific ions and the responses of different common macroinvertebrates in Central Appalachian streams. Many studies demonstrate a correlation between benthic macroinvertebrate diversity loss from general land disturbance (Freeman and Schorr 2004, Ely and Wallace 2010, Hedrick et al. 2010, Merovich Jr. and Petty 2010, Merriam et al. 2011, Gangloff et al. 2015) in this region as well as disturbances associated with surface and underground coal mining (Pond 2010, Merriam et al. 2013). However, these efforts highlight correlation, which does not explain the mechanisms of causation.

Laboratory and field research demonstrating links between specific ion suites and biological diversity loss is required to establish an improved standard that is protective of sensitive Appalachian headwater species. Recent work from British Columbia evaluating sensitivity of fish in a laboratory study of SO_4^{2-} suggests aquatic life standards for SO_4^{2-} between 100 and 250 mg/L depending on water hardness (Elphick et al. 2011a). Other testing of *Ceridaphnia dubia* tolerance to chloride confirmed water hardness as a factor (Elphick et al. 2011b). The mining-impacted groups in this study and in an earlier study (Cook et al. 2015) show average SO_4^{2-} concentrations two to three times the suggested Canadian standard, and SO_4^{2-} compounds explain the most variance in VSCI score suppression here. Because the sensitivity of general benthic macroinvertebrates is likely to be much higher than that of fish, further laboratory studies are needed to examine the relationship between SO_4^{2-} and sensitive Central Appalachian taxa. By including water hardness as a factor, results could be applicable to surface waters affected by both acid and alkaline mine drainage. Furthermore, quantification of SO_4^{2-} effects and benthic macroinvertebrate taxa would be more informative and specific than the current efforts linking general conductivity and benthic species loss.

In the field, an increasing number of studies have begun to focus on specific ions and their relationship with benthic macroinvertebrate diversity in the Appalachian region and, like this study, identify acid and alkaline mine drainage-related ions as drivers of species loss (Freund and Petty 2007, Merriam et al. 2015). Notably, Merriam et al. (2015) is the only additional study the authors have identified that includes UHW as a measurable pollutant source. Indeed, all pollutants must be considered in the long term. UHW discharges need to be sampled directly and characterized so as to better understand the pollutants they contribute and what specific form they take. Similarly, further field studies of coal mining and natural gas extraction-related discharges need to be similarly quantified in terms of specific ions. Once these specific compounds have been identified, WETT testing such as the aforementioned studies should be undertaken using pollution intolerant EPT genus such that effects on sensitive species can be quantified. From these studies, specific pollutant relationships for this region could be illustrated, allowing effective mitigation to be pursued by relevant stakeholders.

Acknowledgements
Special thanks are given to the Appalachian Research Initiative for Environmental Science (ARIES) for funding this work; the Laboratory for Interdisciplinary Statistical Analysis (LISA) at Virginia Tech for assisting with statistical analysis; Travis Lowe and Tim Compton at Appalachian Technical Services, Inc. in Wise, Virginia for field support; and to several students at Virginia Tech who contributed countless hours of lab, field, and prep work including Vickie Nystrom, Sara Gotkurk, Rory Coffey, and Tyler Faulkner

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CHAPTER 6. PUTTING CORPORATE SOCIAL RESPONSIBILITY TO WORK IN MINING COMMUNITIES: EXPLORING COMMUNITY WASTEWATER NEEDS IN CENTRAL APPALACHIA

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Submitted: February 2015
To: Resources
Status: Accepted April 2015

Abstract

Due to the finite nature of non-renewable mineral and energy resources such as coal, resource extraction is inherently unsustainable; however, mining and related activities can contribute to sustainable development. Indeed, the principles of corporate social responsibility (CSR) require that mine operators design and conduct their activities in ways that provide for net positive impacts on surrounding communities and environments. In Central Appalachia, there appears to be a particularly ripe opportunity for the coal industry to put CSR to work: participation in sustainable solutions to the long-standing problem of inadequately treated wastewater discharges—which not only represent a potential human health hazard, but also contribute to the relatively high incidence of bacterial impairments in surface waters in the region. In this paper, we outline the underlying factors of this problem and the advantages of industry-aided solutions in a region where limited economic and technical resources are not always aligned with social and environmental needs. We also suggest a framework for problem-solving, which necessarily involves all interested stakeholders, and identify the primary challenges that must be overcome in pursuit of sustainable solutions.

Introduction

Sustainable development was formally defined by the Brundtland Commission in 1987 as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" and has since taken on subtly different meanings in different contexts. In fact, since this ground-breaking inception, the term has come to encapsulate many different meanings to different stakeholder groups; some more complete than the original, and some more convoluted [1]. To many, sustainable development is a balancing act; it attempts to provide benefits to society without adversely impacting the environment or economy [2]. In the business sense, "Corporate Social Responsibility" (CSR) pertains to a commitment to corporate action that results in net positive impacts in realms outside of those focused on purely financial drivers for the corporation, e.g., social, socio-economic and socio-environmental development. Importantly, both sustainable development and CSR suggest that industry members have an obligation to respect and contribute to the communities in which they operate. For the mining industry, this expectation has become particularly clear in recent decades as global attitudes towards mineral extraction have shifted. Local communities, the public at large, government entities, and investors are demanding transparency, accountability, and a measurable commitment to best practices and continuous improvement [3,4].

To meet these demands and ensure that mining projects are better aligned with the principles of sustainable development, the past two decades have seen significant efforts to produce guidance and tools for mine operators, as highlighted by the work products of a number of international organizations such as the Global Mining Institute (a meeting of global mining companies in 1998) and the International Council on Mining and Metals (founded in 2001). Many of these efforts have focused specifically on the aim of ensuring that resource projects are developed in a manner consistent with gaining and maintaining a social license to do business, which necessarily hinges on stakeholder engagement and education, particularly within local communities, and industry commitment to transparency in information exchange and timely conflict resolution [4]. The Mining, Minerals and Sustainable Development (MMSD) Project. identified the most significant challenges faced by the global mining industry [5], and its North American branch then used those challenges as guideposts to develop a framework for the assessment of mining projects within the context of sustainable development. The MMSD was created via a collaboration of the World Business Council for Sustainable Development and the International Institute for Environment and Development and is largely funded by a mixture of government organizations, international agencies, private foundations, and corporate donors. In the report Seven Questions to Sustainability: How to Assess the Contribution of Mining and Minerals Activities, a framework is provided to evaluate, and ultimately enhance, contributions of current and proposed projects across local to global scales, using seven broad guiding questions provided in Table 1 [6]. Affirmative responses to any of the questions may signal positive contributions of CSR activities, though those associated with "people," "environment", and "traditional and non-market activities" are likely to be the most tangible.

Table 6-1. The Seven Questions to Sustainability [7]

Question Category	Issue Addressed
Engagement	Are engagement processes in place and working effectively?
People	Will people's well-being be maintained or improved?
Environment	Is the integrity of the environment assured over the long term?

Economy	Is the economic viability of the project or operation assured, and will the economy of the community and beyond be better off as a result?
Traditional and Non-Market Activities	Are traditional and non-market activities in the community and surrounding area accounted for in a way that is acceptable to the local people?
Institutional Arrangements and Governance	Are rules, incentives, programs and capacities in place to address project or operational consequences?
Synthesis and Continued Learning	Does a full synthesis show that the net result will be positive or negative in the long term, and will there be periodic reassessments?

Efforts to implement sustainable development practices by mining companies have achieved varying levels of success and impact; scale and corporate motives and commitment often play a part in defining ultimate outcomes. While CSR is frequently a part of national discussion of resource extraction practices in developed countries like Canada [8] and Australia [9], the concept of CSR is gaining traction in developing countries across Africa [10] and South America [11] as well. Past or ongoing examples are available from all corners of the globe, with deliberate corporate interventions ranging from small infrastructure projects, to environmental improvement and management efforts [12], to specific high-priority community health-related projects [13,14], to full-scale community development [15,16] or even attempts toward conflict resolution in war-torn nations such as Angola [17]. Regardless of scale and the particular community or environmental need addressed, one parallel between all success stories is a strong commitment to community engagement and at least some degree of social license. Genuine community engagement requires open, honest and regular communication with stakeholders in order to gain an appreciation and understanding of local needs and problems—and also involvement of local people in the development and implementation of community-approved solutions.

In this vein, calls for more inclusive approaches to decision-making and problem solving have been tendered with emphasis on meaningful public participation in questions of ecosystem valuation, post-mining land use, and community development [18] in Central Appalachia. To address community problems, environmental and sociological characteristics must be defined, which will allow the specific needs of regional communities to be outlined. By necessity, this includes a determination of stakeholders and their relationships to each other. Finally, the available resources in the region have to be identified and aligned towards desired solutions to community issues. Using this crucial suite of information, solutions can be pursued within a framework of sustainable development. The goal of this paper is to explore the processes by which sustainable development and CSR principles could potentially lead to resolutions to a common community and environmental problem in Central Appalachia: inadequate residential wastewater treatment and associated impacts on water resources. The issue of inadequately treated sewage discharges in Central Appalachia is a complex one. In highly developed nations, basic sanitation problems are somewhat surprising, and indeed publicly available information in citable documents is scarce. Over several years of dialogue with local residents, public health officials, regulators, and industry representatives, we have gained evidence that sewage discharges are more than an anecdotal concern of a diverse group of stakeholders in this region. In reality, the scope and challenges associated with solutions represent a complicated interplay of history, politics, and economics that make the problem perhaps even more complex than in developing countries. The goal of this paper is not to highlight specific cases of sewage discharges in Central Appalachia, but rather to broadly discuss the issue within the context of CSR and to present a common-sense approach to finding mutually beneficial solutions where regional stakeholders can cooperate and coordinate efficient use of limited available resources. Within this context, this discussion aims to add to the global dialogue on the critical nature of public-private partnerships in sustainable development.

Mining CSR in Appalachia

Unique Opportunities for Community Solutions

Appalachia broadly refers to a cultural region in the eastern U.S. (US) which the Appalachian Regional Commission (ARC) geographically defines to include 420 counties in thirteen states ranging from New York in the north to Alabama and Mississippi in the south [19]. The "Central" Appalachian region, which generally includes Kentucky, Maryland, Ohio, Pennsylvania, Virginia, and West Virginia (Figure 6-1) accounts for the majority of the fossil energy production (i.e., coal and natural gas) in greater Appalachia, and is currently at the center of several debates on related issues of environmental and social justice [20,21]. In many ways Appalachia is a historical microcosm of the United States throughout its turbulent history; Appalachia has struggled with inequality between established residents and migrant workers, it was divided during the American Civil War, and it was the first region of the U.S. to struggle with deindustrialization. Given its long history of conflict and the widespread natural resource extraction activities in this region, issues related to coal mining can be particularly controversial and emotional for various regional stakeholders. In general, coal operators and related corporations in Central Appalachia tend to be U.S.-based, while the broader U.S. coal industry includes some multinational corporations such as BHP Billiton and Rio Tinto [22].

Although the Central Appalachian region consists of many areas with significant natural resources in the form of coal and natural gas, economic growth in these communities generally lags behind the national average and has for decades. In fact, a unique federal agency called the Appalachian Regional Commission was created by an act of Congress in 1965 and has sought to stimulate the economy in the region since that time. The most recent economic report on the region published by the ARC indicated that Central Appalachia significantly trailed the national average in terms of employment, personal income, income per capita, investment income, and proprietor average income [23]. As detailed by Glasmeier and Farrigan [24], billions of investment dollars by the federal government over several decades have not succeeded in lifting all isolated communities of Central Appalachia out of poverty. A significant reason for the apparent disparity between resource richness and economic depression is often that the land where the wealth of resources is located is owned by outside parties. These entities then lease the land to mining and gas operators who then remove the resources for profit. Jobs in this region are strongly linked to natural resource extraction industries and are heavily influenced by state and national energy policies. These links make the job market in Central Appalachia an entity constantly in flux [24]. Regardless, resource extraction remains a mainstay of the regional economy with more than one third of US coal production occurring in Central Appalachia, employing over 60,000 people in the larger Appalachian region [22].

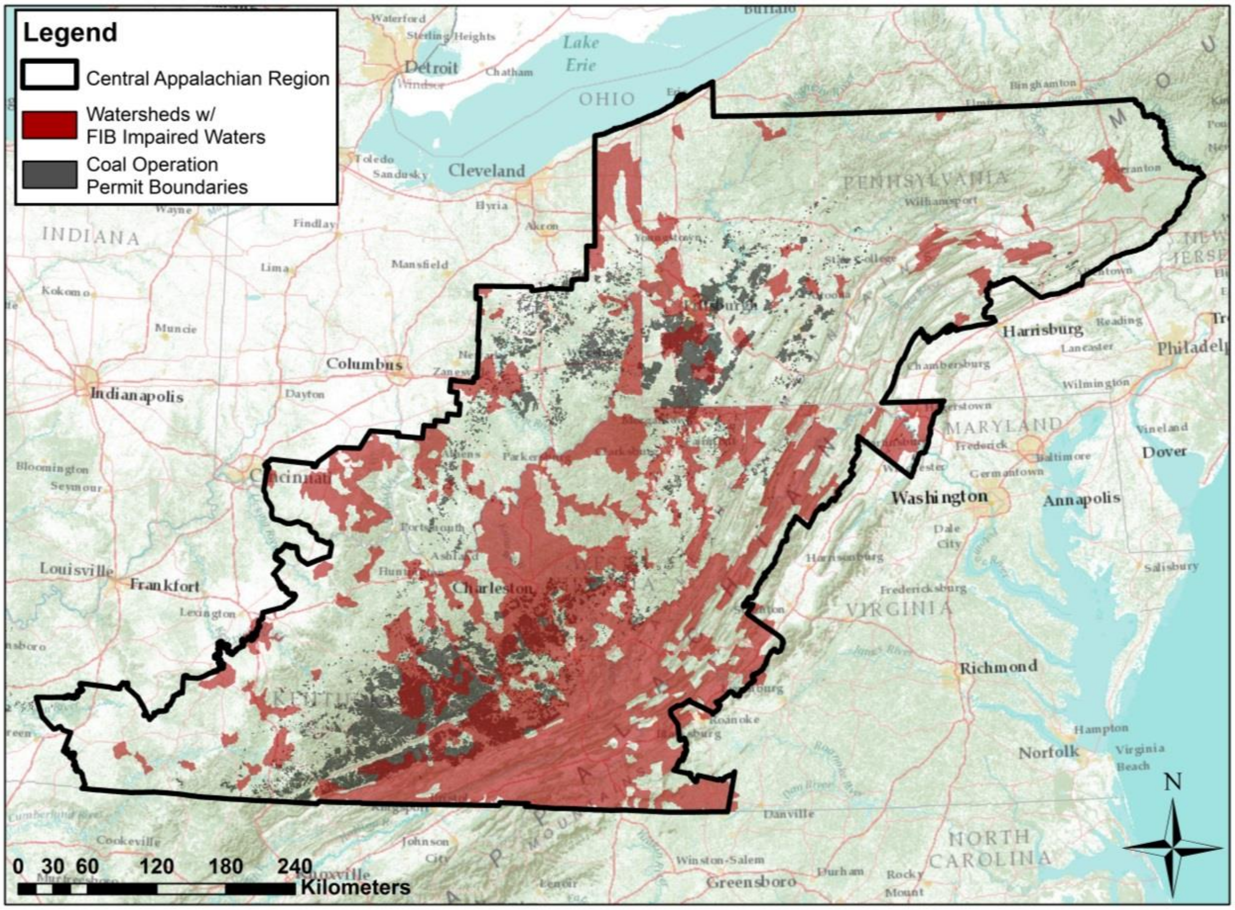

Figure 6-1. Central Appalachian Region Political Boundaries, Mining Extents and FIB-Impacted watershed areas (including historical mining extents, current permit boundaries, refuse sites, and valley fills in grey). (Data collected from Pennsylvania Spatial Data Access, Ohio Geographic Management Systems, West Virginia Department of Environmental Protection, Virginia DMME, and the Kentucky Geological Survey).

In some states, the total area impacted by past and present coal mining operations is extensive, with current estimates indicating that over 30,000 km2 have been disturbed at some point in Central Appalachia alone. Figure 6-1 provides the regional boundaries overlaid with a compilation of mining activity extents (i.e., permit boundaries, refuse sites, and valley fills), illustrating the significant geographic influence of the mining industry. However, as a consequence of this expansive presence (along with its temporal stability as both an economic player and community member), the mining industry is also a potentially important contributor of both financial and technical resources when addressing local sustainability issues. Employees of local coal mine operations are often local citizens with intimate knowledge of community social groups and attitudes, as well as local concerns. Thus, it could be argued that the mining industry may be a significant agent for change in a region that is undoubtedly in need of new models and drivers for sustainable growth and development.

Many examples of industry support for general infrastructure improvements exist globally; sustainable development and CSR approaches allow the mining industry to contribute to specific community issues such as provision of clean drinking water [14], healthcare [13], and economic development coupled with environmental and cultural preservation [12]. In larger-scale efforts, CSR contributions become synonymous with full-scale community development, and mining operations actually lead efforts to build roads, provide electricity, and install basic sewer and water service in local regions [15,25]. For the purposes of this discussion, sewerage and sewer service are synonymous, while sewage, refers to the actual household waste itself. Beyond the benefits these efforts provide in opportunities for building public-private partnerships, acquiring and maintaining social license, and improving the standard of living for whole communities, they can also be a form of political risk management in conflict-prone regions of the world when successful [17].

In particular regions of the United States, similar dynamics relative to these international examples are common. Without a strong centralized municipality or tax base, infrastructure needs often outpace local funding. In Central Appalachia and other rural areas (where mining operations are often located), infrastructure maintenance is in some cases shifting from a centralized municipality-driven paradigm to a county-wide effort [26] with an emphasis on public-private partnerships or corporate dollars as a partial funding source. In West Virginia, there is a state-mandated process whereby a coal severance tax provides funding for county-level infrastructure maintenance [27]. Although a legal driver, not CSR, is behind these funds, it does demonstrate recognition of corporate responsibility to give back to the communities by state government. In more localized examples, large-scale sewer service improvements have been proposed in Nevada [28,29] and small-scale package plants have been installed in southwestern Virginia [30] via carefully orchestrated efforts between governmental organizations, private industry, NGOs, and community organizations. The case of sewerage in Central Appalachia is of particular concern because of potential related public and ecosystem health concerns.

The Specific Case of Bacterial Surface Water Impairments in Central Appalachia

Many communities in Central Appalachia have evolved from former “coal camps” in narrow mountain hollows along streams. This geographic isolation, coupled with the chronically depressed socio-economic status of the region, has resulted in an often underappreciated problem: lack of proper sewerage for household waste. Many of the rural counties in the area are comprised of isolated communities without a sufficiently large central municipality to organize widespread infrastructure efforts. Under such conditions, it is not surprising that centralized or advanced wastewater treatment systems are not always present or even plausible for all residences. While historical precedent (i.e., the justification that “it’s always been this way”) or a lack of understanding regarding potential consequences may contribute to the prevalence of this deficiency, inadequate water and sanitation issues in the U.S. are often largely economic and/or political. These issues most often plague minority populations or economically distressed populations centered in poor urban areas or rural areas such as Central Appalachia [31,32]. In many Central Appalachian communities, residents are aware of the problem but lack the resources to take any effective action.

In many cases in small rural Central Appalachian communities, septic tanks are installed in an attempt to treat sewage; however, soils in the region are notoriously thin and often inadequate for proper septic system functioning. Housing density within narrow “hollows” can also render appropriate siting of drain fields difficult. Even adequately installed septic systems can contaminate local water resources, since near-surface groundwater flows through karst geological strata and may interact with septic system drain fields [33,34]. In some cases, partially treated water from septic tanks or “grey water” (i.e., water from residential activities like washing dishes) is discharged into trenches that run into streams. And in the worst-case scenario, no treatment approach exists at all and residential waste, including wastewater from toilets, is piped directly to a creek or stream—a practice known as "straight-piping".

The process of straight-piping may be one of many contributors to bacterial loadings of pathogen indicators (*E. coli*, fecal coliforms, and enterococci) in Central Appalachia, and in terms of immediate human health implications is likely the most concerning. Although generally non-pathogenic themselves, the presence of indicator organisms is associated with contamination by mammalian fecal material and exposure is linked to health risk [35]. Exposure to waters containing high concentrations of coliform or enterococci bacteria have been linked with an elevated risk of gastroenteritis, respiratory infections, and skin infections in humans [36]. In addition to the general health risks themselves, the exposure to waterborne illnesses is an economic stressor; hospitalization and out-patient care for these diseases cost over $800 million annually in the US, not including lost work time and productivity [37] Common sources of pathogen loadings to receiving waters include wastewater discharges (both from municipal treatment facilities and individual households), wildlife, domestic animals, and runoff from manure-amended agricultural soils [38,39]. Recent research has indicated that these impairments occur in mainly forested watersheds with low population densities (rural watersheds) and not much agriculture in Central Appalachia [40]. Because development is dense near stream beds, this fact seems to indicate that straight-piping may be a significant contaminant source in cases of bacterial impairment.

From a regulatory perspective, primary water quality concerns in Central Appalachia focus on the abundance and diversity of stream macro-invertebrates (the bottom of the macro-scale food chain in streams), which are often used as a proxy for the general degradation of stream ecology [41,42]. The assumption is that if the base of the food chain is healthy, the upper level organisms will also thrive. The RBPs also detail protocols for examining fish populations as well as periphyton (algae). This emphasis began in 1986 with an initial EPA study of surface water monitoring methods, which recommended a future emphasis on biological monitoring. In 1989 the Assessment and Watershed Protection Division of the EPA developed rapid bioassessment protocols (RBPs) designed to provide cost-effective biological data [43]. Today, several states have developed their own specific methods of RBP assessment as understanding of benthic ecology and water quality continues to evolve. It is critical to note that these assessments only determine the quality of the benthic communities present, and often require additional data to determine the causes of any observed impairment. While untreated residential discharges may certainly contribute to macro-invertebrate stress [44] as well as human health risks [35] and associated costs [37], they currently receive relatively little attention. As in other regions of the US, regulatory efforts are generally focused on large discharges (e.g., industrial, commercial and municipal point sources).

In Central Appalachia, a very significant number of those discharges are in close proximity to ongoing coal mining activities, which means that the mining industry has a significant role to play in regional water quality management. Clearly, mine operators are not directly contributing to bacterial loadings to receiving waters in this region, but their widespread presence and needs for water-related permits present a heretofore untapped opportunity for sustainable solutions. GIS data was collected from the states of Central Appalachia and analyzed via a formalized approach in a previous study [40] where stream impairment layers and coal mining permit boundaries were compared through spatial analysis. Figure 6-2 represents a purely illustrative example using data from the West Virginia Department of Environmental Protection (impaired streams) and the West Virginia Natural Resource Analysis Center (permit boundaries). Figure 6-2 shows FIB impairments in a specific area of West Virginia (in red) and different impact scenarios of mining industry participation in mitigation (in yellow) on a direct drainage level, a watershed level, and a community level (assuming a 10 and 25 km radius from a mine permit boundary to simulate community variability). Calculations associated with the specific area shown in Figure 6-2 indicate that roughly 11 km of stream could be addressed on a drainage basis, 52 km on the watershed basis, and almost 114 (10 km radius) to 620 (25 km radius) km on a "community" basis. Figure creation and calculations were based on analysis using ArcMap (ESRI Products, Redlands, CA, USA, www.esri.com). Stream mileage calculations were performed using GIS to determine the cumulative stream miles based on mitigation level. Direct-drainage and watershed level mitigation potential was calculated by summing impaired stream miles within the boundary of the permit area and watershed boundary, respectively. Community-level mitigation potential was calculated by creating 10 km and 25 km radii around the mining permit boundary in GIS and summing impaired stream miles within the potential sphere of influence. These calculations clearly assume that all impairments could be successfully addressed by some intervention involving mining operation participation. Based on a similar assumption, a previous study showed that throughout the Central Appalachian region, mining operations could at least attempt interventions for roughly 77% of all bacterial impairments [40].

While the example analysis above is hypothetical, though based on real water impairment and mine location data, it illustrates the magnitude of potential impacts that might be realized if the mining industry was incentivized to contribute to sustainable development of the region by improving human health and environmental quality. Historically, sustainable development has not been a direct aim of the mining industry, but globally the trend towards corporate social responsibility (CSR) and sustainable development has pushed the industry to consider new paradigms [4]. While application of these new paradigms may be less complicated in developing economies, opportunities in developed economies such as the U.S. should not be overlooked. It should be noted that CSR efforts toward infrastructure are likely to be much simpler in less complex regulatory environments such as those in still developing economies. Infrastructure implementation projects in developed economies are likely to be more costly and fraught with bureaucratic hurdles; however, these activities may be more necessary to earn the necessary support of local communities, broader public opinion, and regulatory officials charged with protecting the environmental quality of the region..

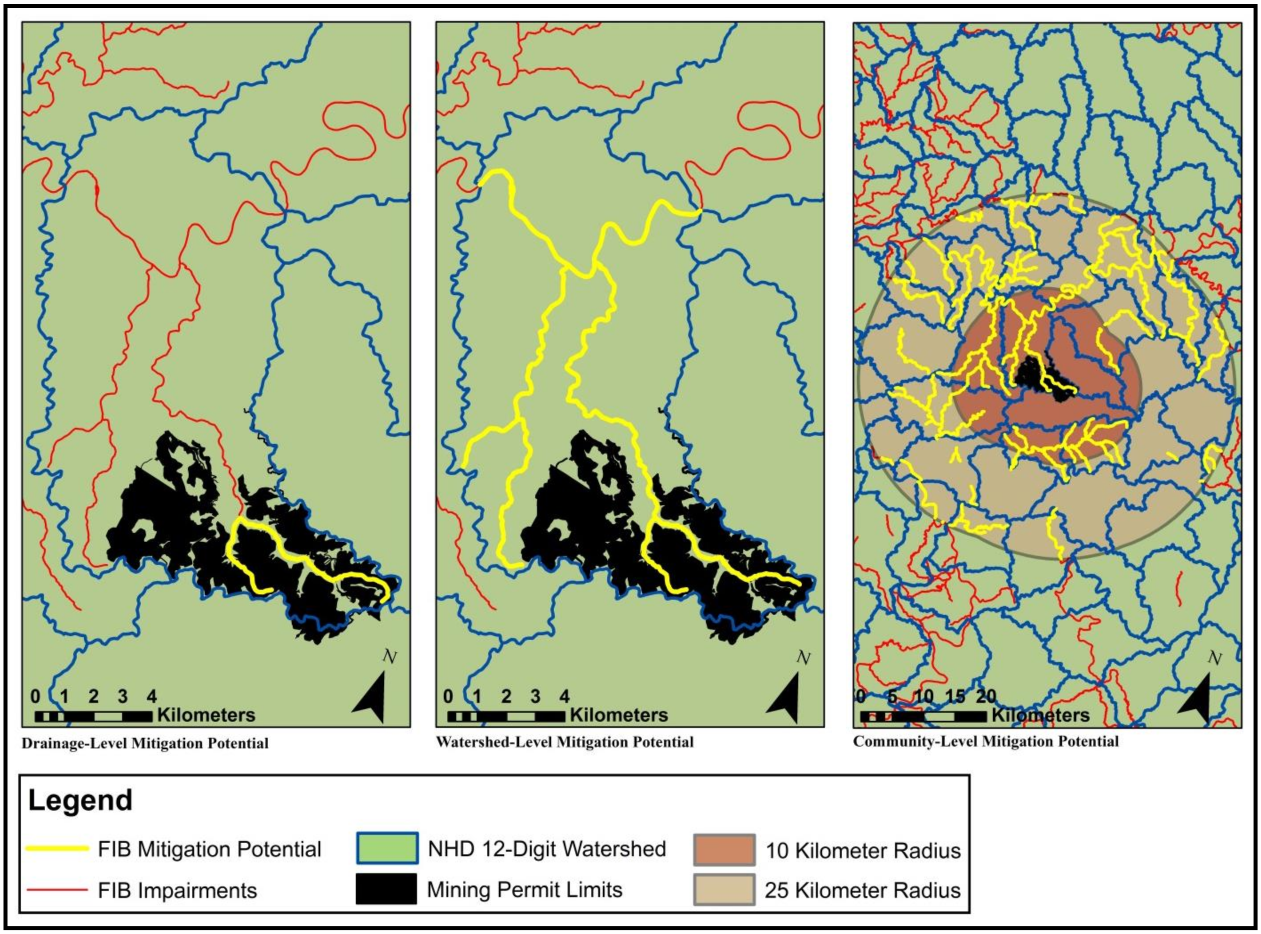

Figure 6-2. Permit, Watershed, and Community-Level Mitigation Impacts from Mining Operations

The Need for Resource Alignment

In Central Appalachia, opportunities do seem to exist for addressing some community issues like bacterial surface water impairments. By proceeding with a sustainable development-driven approach, mining operations can contribute to the maintenance of their social license to operate in the region. For the purposes of this discussion, "social license" is used synonymously with the term "license to operate," which refers to the permission granted by local community members to nearby coal operators to pursue resource extraction activities [3]. Social license can exist on two levels: the community social license, which represents those living in close proximity to resource extraction activities, and the public opinion social license, which refers to a national or global attitude towards resource extraction activities. The process of building this social license includes an inventory of resources, which requires all stakeholder groups in the community to evaluate their own potential contributions towards a broadly acceptable and mutually beneficial solution. Resource extraction in Central Appalachia is often controversial and can, along with the socio-economic characteristics of the region, lead to conflict or stalemate amongst varying stakeholder groups over perceived conflicting priorities. Aside from the mining industry and oppositional groups, other stakeholders of importance in the region include community residents, non-profit advocacy groups, federal and state regulatory agencies, public service organizations, and local governments. Using the sewerage issues in some areas of Central Appalachia as a hypothetical focus, each of these groups brings important resources to the table to address this problem, but no single group appears to have the necessary means to implement a long-term solution. The issue of sewage-related bacterial impairments in local water resources is an environmental health concern, and mine operators are already often the primary players in regional water quality management—i.e., in terms of their legal obligations to receive and comply with permits.

With such complex social and political relationships in the region, a first step towards an analysis of sustainable solutions to bacterial impairments is to identify available resources. Figure 6-3 illustrates these stakeholder groups (derived from general literature review, interactions with local officials, and field experience), the obstacles that hinder them from implementing solutions and their "sustainability capital" (i.e., the resources they bring to the table). In Figure 6-3, "community industries" refer to local natural resource extraction operators (whether it be coal, natural gas, or otherwise), while NGOs may refer to community based or nationally based NGOs. Similarly, regulatory agencies are comprised of multiple scales: local, state and federal regulatory agencies all hold sway on community-level activities. Social license is used here as defined above, while "funding" refers to the financial ability to pay the cost of infrastructure project realization from conceptual design phases through construction and maintenance stages "Scientific Community" represents researchers and academics who may contribute funding and expertise to projects through grants, field research, and laboratory analysis.

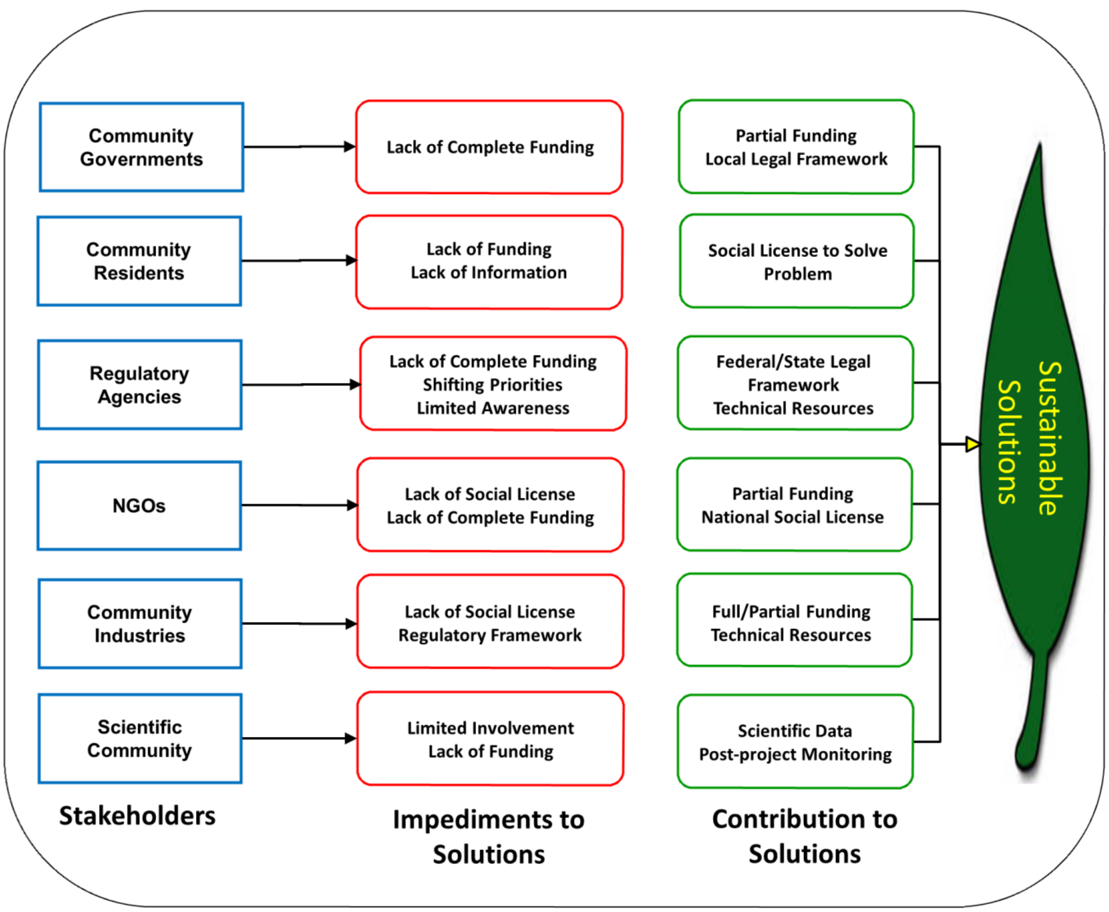

Figure 6-3. Stakeholders, Impediments, and Sustainability Capital in Central Appalachia

One of the main resources necessary for implementing any solution, whatever it may be, is social license, financial resources, and a federal, state, and local legal framework that not only allows the mining industry to participate in problem-solving, but provides incentives such that participation is the most attractive option. Tangible incentives are particularly important because of the relatively large initial capital investment that is necessary for infrastructure improvements in these communities. Currently, legal language does exist that would allow mining operators to apply mitigation efforts to sewerage improvements or to pay in-lieu mitigations fees (fees in place of direct actions) in some cases. [45]. However, this alternate avenue is often only available when no other state or local government has "affirmative obligation" on which to act and sufficient ambient water quality monitoring exists to officially classify streams as impaired. In other words, if an agency such as a state EPA or local municipality have legal obligation to address impairments, it is difficult (if not impossible) for industries to contribute to solutions, even if governmental resources and/or motivation appears insufficient. Few permits have been approved using this type of broad mitigation planning, so industry-aided solutions to these sewerage issues continue to elude motivated stakeholder groups in local communities.

Although the process remains complex, Figure 6-3 suggests that the necessary components for developing and implementing solutions to sewerage issues in Central Appalachia do presently exist. It is worth noting, however, that within each of these very broadly defined stakeholder groups exist multiple sub-groups, some of which are in regular opposition or lack clear means of productive communication. Example issues illustrative of the complexity of stakeholder inter-relationships and potential burden of responsibility include:

- Stream impairments should be addressed by TMDL implementation in accordance with 303(d) impairment listings, but what happens when the private citizens responsible for discharges do not have the means to reduce contaminant discharges (e.g., insuffficent finances to re-design sewage treatment systems)? (TMDL: Total Maximum Daily Loads are plans designed to reduce pollutant loads in impaired water bodies to levels acceptable to standards detailed in section 303-d and 305-b of the Clean Water Act of 1972 [46] and subsequent EPA technical bulletins [47,48]; states are required to assess water bodies based on their designated use and report on those assessments under section 305-b. When waters are assessed as 'impaired' they are added to the 303-d list.)
- Assuming initial capital investment in sewerage improvements are provided by industry, can the system be maintained without a local government entity to take responsibility?
- Can local residents afford to pay a sewer bill or tax to provide maintenance funding?
- Is *E. coli* presence in their streams sufficiently concerning that paying such a fee would be acceptable to these residents?
- What further research/outreach is required to evaluate residents' willingness to pay and the worth of indivudal benefits?
- Are there sufficient downstream human and ecological health issues related to straight-piping such that a legal framework for industry involvement in solutions will be acceptable to regulators?

While the scientific, financial, and logistical elements of this issue are challenging, the most complex aspect of implementing community solutions to bacterial impairments is likely improving communication across stakeholder groups. Communication between external groups and dialogue internal to these groups can be an issue. In some cases, sub-groups are isolated from each other (e.g., various NGOs or community groups that may operate within the region.) Even within governmental organizations, responsibilities are split between federal agencies, state agencies, and local entities, which can create a complicated bureaucracy that impedes the communication process [18]. Conflicts between and within various groups can often stand in the way of progress. Between individual groups, the most obvious conflicts are related to fundamental differences in values and agendas. For example, some environmental and citizen advocate groups are rooted in opposition to coal mining in Central Appalachia [49], which is inherently at odds with the interests of the regional mining industry. For some community members, particular advocacy groups and NGOs are seen as “outsiders” attempting to foist non-local values and priorities on the local region [50]; meanwhile, grassroots advocacy groups may espouse a more nuanced perspective. In the case of outsider NGOs, these groups may represent the voice of a broader outside public opinion, but not have community social license to represent local or regional interests. Regardless of the ultimate goal (e.g., clean water), easing friction between such groups is fundamental to the development of sustainable solutions since stakeholder cooperation is an imperative for effectively addressing community problems.

As shown in Figure 6-3, it is clear that social license is not a one-dimensional entity, but more of a hierarchical structure comprised of community, state, and national levels. Not only must social license be maintained with those in close proximity to projects and activities (i.e., local communities), but also in the court of public opinion at various scales. Although industry efforts might be supported by local residents, if NGOs sway public opinion on a state or national scale, political support for these community-approved projects and activities can be endangered. Therefore, the idea of social license does not only apply in a narrow sense to a local project, but also to the conduct of an industrial entity on a larger scale.

Putting Corporate Social Responsibility to Work

Assuming, in this hypothetical case, the end goal is a broadly acceptable solution that provides adequate sewerage and improves surface water quality, a first step is delineation of a regulatory framework that incentivizes local industry to participate, specifically in providing initial capital investments and technical assistance. A legal framework that “allows” for mine-related water permits to theoretically include sewerage improvements currently exists [45]; however, it has not been successfully utilized largely due to conflicting regulatory priorities at the government level, lack of historical precedent (i.e., successful past projects), or general lack of knowledge about this permitting possibility within the industry. Further incentives may be necessary to garner buy-in from both the industry perspective as well as the federal regulators’ point of view. In a recent court decision in Pennsylvania, courts upheld EPA’s “holistic watershed approach” to addressing nutrients in the Chesapeake Bay watershed via TMDLs that include upstream states that do not directly border the Bay. While this TMDL includes all geographical parties that make up the Chesapeake Bay watershed area, it focuses on a single pollutant (nutrients) rather than a suite of water quality impacts [51]; the next logical step from a geographically inclusive watershed approach focused on a single pollutant is one that analyzes multiple pollutants and prioritizes water quality impacts in a manner that maximizes holistic watershed improvement.

For bacterial impairments in Central Appalachia, this means that a future holistic approach may eventually be developed for multiple pollutants where those causing the most ecological harm are prioritized, opening the door for sewerage projects to regularly be included in the permitting process. Independent peer-reviewed research providing direct evidence of downstream environmental effects and human health risks related to regular sewage discharge would be supportive of these aims. A successful framework would require clear guidelines for acceptable solutions; specific accompanying water quality credits for those contributing to these solutions; and detailed strategies to encourage long-term participation by local residents in solution design and monitoring. Rejected attempts to operate within this framework would require clear explanation of their failings so that the process would not be perceived as a dead end within the mining industry.

Once a clear legal pathway for industry involvement exists, the next step towards solving local sewerage problems is communicating the human and environmental hazards associated with inadequate wastewater treatment to local residents effectively. Because community stakeholder participation is so important in the solution process, guidelines have been developed outlining the creation of community communication strategies and plans for environmental and health risks [52]. Collaboration involving local residents and other stakeholders will only occur once the community is sufficiently aware of the costs of inaction and relative benefits of proposed solutions.

The specifics of the community and the geographical layout of the homes will require different solutions; potential methods include the piping of untreated sewage to a proximate municipal treatment facility, the installation of a local package plant (and supporting sewer lines), or the development of a constructed wetland for grey water filtering (following septic tank pre-treatment). In terms of capital investment, all of these options are likely more costly relative to the financial resources of a single small Appalachian community, but may be a worthwhile investment for local industry members—provided that some sort of "credit" is awarded to reflect resultant improvements downstream (e.g., a company may be incentivized by the opportunity to earn credit towards mitigating impacts of their own water discharges). After installation, results should be monitored by independent groups such that the benefits of each solution implementation are clear, thus perpetuating the social license of such solution processes. Further, initial projects should be monitored by independent scientists so that the effects of each solution can be both identified and quantified.

Given these issues, would the hypothetical implementation of wastewater treatment infrastructure to replace straight-piping in Appalachia be considered a contribution to sustainable development? Reviewed loosely within the framework proposed by Seven Questions to Sustainability, the process appears theoretically sound based on all seven criteria: (1) engagement among stakeholders is enhanced by bringing parties that do not normally communicate together to solve community issues, perhaps in the process also airing and resolving other inter-group frictions; (2) the well-being of residents is undoubtedly improved as potentially harmful bacteria and pathogens (as well as chemicals associated with household waste) would be removed from recreational waters in close proximity to their homes; (3) although observational evidence is presently scant, common sense would indicate that the environment would likely be enhanced by the removal of raw sewage discharge; (4) economic benefit is added to the community by removing health care costs associated with waterborne illnesses as well as the capital cost of new infrastructure; (5) traditional and non-market activities, including recreational activities such as fishing, hiking, and swimming, would be enhanced by improvements in water quality; (6) implementation and operation of wastewater treatment infrastructure using a transparent and inclusive approach, satisfies the category of "Institutional Arrangements and Governance"; and (7) implementation of these solutions, and the monitoring of downstream human and ecological outcomes, contributes to synthesis and continued learning. New knowledge about the effects of sewage on the environment and the benefits of its removal can be studied in areas where these projects are installed, and will likely provide insight into efforts to improve water and sanitation access both locally and globally [32].

As a practical application, the success of this framework depends on managers of local mine operations or corporations. As new mining permits are sought, a manager can assemble a team for community outreach as well as regulatory compliance. The first team could identify community leaders through which local communities can be engaged; would these communities be amenable to local mining taking place? Would community members find value in industry-led efforts at providing them with modern sewerage options? With community support in place, a manager must address regulatory and government stakeholders. Communication with regulators and local governments can build support for such efforts, as well as determine the likelihood of such mitigation efforts to be accepted by the necessary permitting agencies. By communicating with these parties, efforts can move forward with legal support as well as community support. Two final steps are crucial in the broader public image-building process: communicating with NGOs that would support such efforts and researchers (either industry or academic) who could quantify the benefits of such efforts. With stakeholder support in place, permit application can proceed and project design and construction can as well. At the end of infrastructure improvement implementation, managers can communicate their successful results to shareholders and the broader public, illustrating community-building, local government support, processes by which regulators approved such projects, and scientifically-backed results of infrastructure improvement projects.

Conclusions

A unique opportunity exists in Central Appalachia for industry to assist in the improvement of surface water quality. Given the potential human health and ecological impacts of sewage-related bacterial impairments, immediate and serious attention should be given to any possible mechanisms for mitigation. Under current regulatory paradigms, contributions from industry via the construction of package plants, constructed wetlands, or general sewerage improvements are not impossible, but the pathway to associated mitigation credit related to accompanying water quality improvement is unclear at best. Further development of a framework in which mine operators can fund and participate in solutions to these sewerage issues while receiving appropriate regulatory recognition, is not only necessary to make them a reality, but is an opportunity for communication development within local communities and a potential contribution to broader regional sustainable development. Formalizing new paradigms in developed economies is likely to be a protracted effort as the success of individual projects is likely to be affected by local, state, and federal governments in addition to global energy markets and attitudes towards carbon-based energy sources. While the environmental aspects of mining are often a topic of contentious debate, all stakeholders likely agree that untreated sewage has no place in community recreational waters. Resultant understanding of the impacts of successful sanitation improvements will provide useful scientific information for the broader scientific community. To support this paradigm of using public-private partnerships to address local community needs, further research is needed to quantify the financial benefits afforded local communities by such projects, the efficiency of different methods of community-scale wastewater treatment solutions, as well as the environmental benefits of removing untreated sewage from Central Appalachian streams. If solutions to inadequate residential wastewater treatment could be implemented using the principles of CSR and sustainable development, projects in Central Appalachia could join a diverse array of case studies coming from localities across the globe that demonstrate that the mining industry is stepping forward into a new era of community engagement and improvement.

Acknowledgements

The authors would like to thank the Appalachian Research Initiative for Environmental Science (ARIES) for funding a portion of this work. Views expressed here represent those of the authors and not necessarily funding sources. We also thank the many individuals that have graciously contributed field knowledge and experience to our research efforts in Central Appalachia.

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CHAPTER 7. FINAL REMARKS AND SUGGESTED FUTURE RESEARCH

Because an ultimate goal of surface water quality research efforts in the central Appalachian region is, at a minimum, to establish all waterways as supportive of aquatic life, several further research steps are needed. In streams in this region, aquatic life may be stressed because of the introduction of pollutants from various activities; surface or underground coal mining, UHW, or general land disturbance associated with urbanization or other human activities in the region. It is necessary to find a balance between allowable disturbance due to human presence and acceptable ecological conditions. This involves several decisions about what species are important to preserve, what level of protection they garner, and how development activities should be conducted. As a specific extension of the research presented in this dissertation, the following topics would be informative next steps in research:

1. Further characterization of UHW pollution;
2. Whole effluent toxicity testing (WETT) of characterized pollutants from surface coal mining and UHW effluents with supporting field studies;
3. Field studies examining benthic macroinvertebrate community response to mitigation efforts, and potential synthesized recolonization.

Further characterization of UHW pollution

While the results of this dissertation show in concept the characterization of pollutants by inorganic ion suites, further studies are needed to define the resultant ionic pollution from UHW. In many cases UHW discharges are comingled with surface runoff and in-stream ions which may be present from upstream mining or legacy discharges. Direct sampling of UHW would allow for more specific ion characterization as well as bacterial enumeration. This study focused on the inorganic constituents of UHW but no effort was made towards inclusion of organic pollution or other synthetic compounds that may be included in UHW. To summarize the total effects of UHW, all three of these impacts should be further studied and characterized. Better understanding the impactful contents of this pollution source, estimates can be made of known sources in the future, saving future mitigation efforts the extensive effort of effluent sampling. Additionally, by characterizing the specific and quantifiable contributions of UHW to in-stream ionic pollution, mitigation on a watershed scale can correctly prioritize pollution based on its quantified effects, ensuring the most efficient use of funding to maximize aquatic ecosystem health. Further, these discharges may present potentially significant health risks to nearby residents and those who use the waterways for recreation or other contact-related activities.

Whole effluent toxicity testing (WETT) of characterized pollutants from surface coal mining and UHW effluents

Early studies have shown effects of conductivity and chloride solutions on standard test organisms (A.J. Kennedy et al., 2005; J. R. F. Elphick et al., 2011) as well as more sensitive mayfly species (A. J. Kennedy et al., 2004; Echols et al., 2010). Further testing is needed on trace metals, components found in UHW, and a particular focus on SO_4^{2-} compounds such as in a recent Canadian study (J. Elphick et al., 2011). These Canadian studies examined SO_4^{2-} effects on fish; further studies are needed using sensitive benthic macroinvertebrate taxa native to the Appalachian region. The emphasis on SO_4^{2-} compounds stems from the results of this work that suggest SO_4^{2-} and its cation constituents as the major drivers of conductivity in the region as a result of mining activities. Other trace metals and compounds should be added to the study list as further research dictates. These types of studies are vital for determining safe levels of these compounds in surface waters that will allow the preservation of biological diversity in headwater streams.

In addition to WETT studies, field confirmation should be undertaken to ensure that these laboratory-determined levels of pollutants are consistent with field conditions. It may be that further environmental conditions could either strengthen (water hardness) or weaken (habitat degradation) benthic macroinvertebrate resilience to ionic pollution and metal contamination. The natural environment is more like a sound board than a circuit breaker. Variables effecting biological diversity are sliders that need to be fine-tuned to create conditions that are conducive to success, rather than a series of hard limits that are switched on or off. Finding the appropriate "mixes" for biological survivability is a crucial task in ecological engineering and in preserving our native species in the face of human land disturbance.

Field studies examining benthic macroinvertebrate community response to mitigation efforts, and potential synthesized recolonization.

While the second topic focuses on the responses of benthic macroinvertebrate organisms to different pollutant types, this research category would address organism response to efforts at mitigating these effects. What balance of pollution and habitat allow the continued success of biological life? Can mitigation efforts provide habitat improvements to ease the burden of improving water quality? Current efforts at stream restoration in the region are leading to mixed results (Palmer et al., 2014). The study suggests that hydrological function is largely replaced, but that biological and habitat results are lacking. Test restoration efforts monitoring riparian and bank vegetation as well as hydrological stability are needed to determine the proper methods for maximizing benthic macroinvertebrate recovery time, species diversity, and site resilience (biological diversity over time). Particular emphasis should be paid to reconstructing these channels on mountain top mining projects as this represents a unique scenario. Additionally, studies should determine strategic mining plans that leave colonizing headwaters in critical locations that will allow for headwater repopulation of benthic species. These species may take a long time to move from neighboring streams due to the high ridges separating headwater streams (Pond, 2010). The possibility of seeding new restoration sites with lab-raised organisms might be an option for accelerating this recolonization, or strategic mining that leaves upstream tributaries untouched, allowing downstream recolonization. If research efforts can identify methods to successfully recolonize impact stream reaches, it may improve the effectiveness of mitigation efforts, allowing speedier recovery of aquatic life in this species-rich region.

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APPENDIX A. RAW DATA

Table A-1. Site Descriptions and Locations

SITE ID	STATE	STREAM	X	Y	TYPE	PUBLISHED NAME
RF-01	Virginia	Roaring Fork	-82.73	36.92	WQ	RF-01
RF-02	Virginia	Roaring Fork	-82.72	36.93	WQ	RF-02
RF-03	Virginia	Roaring Fork	-82.72	36.94	WQ	RF-03
RF-04	Virginia	Roaring Fork	-82.72	36.95	WQ	RF-04
RF-05	Virginia	Roaring Fork	-82.73	36.96	WQ	RF-05
RF-06	Virginia	Roaring Fork	-82.73	36.97	WQ	RF-06
RF-07	Virginia	Roaring Fork	-82.73	36.97	WQ	RF-07
RF-08	Virginia	Roaring Fork	-82.74	36.97	WQ	RF-08
RF-09	Virginia	Roaring Fork	-82.75	36.98	WQ	RF-09
CC-01	Virginia	Callahan Creek	-82.78	36.91	WQ	CC-01
CC-02	Virginia	Callahan Creek	-82.79	36.92	WQ	CC-02
CC-03	Virginia	Callahan Creek	-82.80	36.92	WQ	CC-03
CC-04	Virginia	Callahan Creek	-82.79	36.94	WQ	CC-04
CC-05	Virginia	Callahan Creek	-82.80	36.94	WQ	CC-05
CC-06	Virginia	Callahan Creek	-82.80	36.94	WQ	CC-06
CC-07	Virginia	Callahan Creek	-82.79	36.95	WQ	CC-07
CC-08	Virginia	Callahan Creek	-82.79	36.95	WQ	CC-08
CC-09	Virginia	Callahan Creek	-82.79	36.95	WQ	CC-09
CC-10	Virginia	Callahan Creek	-82.79	36.95	WQ	CC-10
CC-11	Virginia	Callahan Creek	-82.79	36.95	WQ	CC-11
CC-12	Virginia	Callahan Creek	-82.80	36.94	WQ	CC-12
CC-13	Virginia	Callahan Creek	-82.82	36.95	WQ	CC-13
CC-14	Virginia	Callahan Creek	-82.82	36.95	WQ	CC-14
CC-15	Virginia	Callahan Creek	-82.83	36.96	WQ	CC-15
LCVA-01	Virginia	Looney Creek VA	-83.10	36.84	WQ	LCVA-01
LCVA-02	Virginia	Looney Creek VA	-83.11	36.85	WQ	LCVA-02
LCVA-03	Virginia	Looney Creek VA	-83.11	36.85	WQ	LCVA-03
LCVA-04	Virginia	Looney Creek VA	-83.12	36.85	WQ	LCVA-04
LCVA-05	Virginia	Looney Creek VA	-83.14	36.85	WQ	LCVA-05
LCVA-06	Virginia	Looney Creek VA	-83.15	36.85	WQ	LCVA-06
LCVA-07	Virginia	Looney Creek VA	-82.79	36.90	WQ	LCVA-07
LCVA-08	Virginia	Looney Creek VA	-82.79	36.90	WQ	LCVA-08
LCKY-01	Kentucky	Looney Creek KY	-82.80	36.91	WQ	LCKY-01
LCKY-02	Kentucky	Looney Creek KY	-82.80	36.91	WQ	LCKY-02
LCKY-03	Kentucky	Looney Creek KY	-82.82	36.91	WQ	LCKY-03
LCKY-04	Kentucky	Looney Creek KY	-82.82	36.92	WQ	LCKY-04
LCKY-05	Kentucky	Looney Creek KY	-82.82	36.92	WQ	LCKY-05
LCKY-06	Kentucky	Looney Creek KY	-82.84	36.92	WQ	LCKY-06
YC-01	Kentucky	Yocum Creek	-82.94	36.97	WQ	YC-01
YC-02	Kentucky	Yocum Creek	-82.91	36.96	WQ	YC-02

YC-03	Kentucky	Yocum Creek	-82.90	36.96	WQ	YC-03
YC-04	Kentucky	Yocum Creek	-82.89	36.95	WQ	YC-04
YC-05	Kentucky	Yocum Creek	-82.89	36.95	WQ	YC-05
YC-06	Kentucky	Yocum Creek	-82.87	36.93	WQ	YC-06
YC-07	Kentucky	Yocum Creek	-83.19	36.87	WQ	YC-07
YC-08	Kentucky	Yocum Creek	-83.17	36.86	WQ	YC-08
YC-SPRING	Kentucky	Yocum Creek	-83.11	36.85	WQ	YC-SPRING
CCB01	Virginia	Callahan Creek	-82.79	36.92	BENTHIC	CC-B01
1222.01-CC1	Virginia	Callahan Creek	-82.80	36.94	BENTHIC	CC-B02
1222.01-CC2	Virginia	Callahan Creek	-82.79	36.95	BENTHIC	CC-B03
1222.01-CC3	Virginia	Callahan Creek	-82.79	36.95	BENTHIC	CC-B04
360.39-CC2	Virginia	Callahan Creek	-82.78	36.95	BENTHIC	CC-B05
930.02-CC1	Virginia	Callahan Creek	-82.78	36.96	BENTHIC	CC-B06
532.23-CC1	Virginia	Callahan Creek	-82.78	36.97	BENTHIC	CC-B07
1222.01-CC5	Virginia	Callahan Creek	-82.79	36.98	BENTHIC	CC-B08
360.39-CC1	Virginia	Callahan Creek	-82.79	36.99	BENTHIC	CC-B09
1222.01-MB1	Virginia	Callahan Creek	-82.79	36.95	BENTHIC	CCMB-B01
956.25-MLC2	Virginia	Callahan Creek	-82.80	36.94	BENTHIC	CCML-B01
956.25-MLC1	Virginia	Callahan Creek	-82.82	36.95	BENTHIC	CCML-B02
956.25-HB1	Virginia	Callahan Creek	-82.82	36.95	BENTHIC	CCMLHB-B01
316.24-UTCC1	Virginia	Callahan Creek	-82.78	36.97	BENTHIC	CCUT-B01
360.39-WF1	Virginia	Callahan Creek	-82.79	36.98	BENTHIC	CCWF-B01
SLC4.31	Kentucky	Looney Creek KY	-82.92	36.97	BENTHIC	LCKY-B01
SLC8.14	Kentucky	Looney Creek KY	-82.88	36.94	BENTHIC	LCKY-B02
LCVAB01	Virginia	Looney Creek VA	-82.79	36.90	BENTHIC	LCVA-B01
1184.03-SW7	Virginia	Looney Creek VA	-82.83	36.92	BENTHIC	LCVA-B02
1184.03-SW4	Virginia	Looney Creek VA	-82.84	36.92	BENTHIC	LCVA-B03
1184.03-SW4R	Virginia	Looney Creek VA	-82.84	36.92	BENTHIC	LCVA-B04
1035.09-UT1LC1	Virginia	Looney Creek VA	-82.84	36.92	BENTHIC	LCVA-B05
1035.09-UT1LC2	Virginia	Looney Creek VA	-82.85	36.92	BENTHIC	LCVA-B06
1035.09-UT2-LC1	Virginia	Looney Creek VA	-82.85	36.92	BENTHIC	LCVA-B07
RFB01	Virginia	Roaring Fork	-82.72	36.92	BENTHIC	RF-B01
825.07-RF1	Virginia	Roaring Fork	-82.73	36.97	BENTHIC	RF-B02
RFB02	Virginia	Roaring Fork	-82.73	36.97	BENTHIC	RF-B03
RFB03	Virginia	Roaring Fork	-82.74	36.97	BENTHIC	RFPF-B01
68.39-PF1	Virginia	Roaring Fork	-82.75	36.98	BENTHIC	RFPF-B02
68.39-PF2	Virginia	Roaring Fork	-82.75	37.00	BENTHIC	RFPF-B03
825.07-PF1	Virginia	Roaring Fork	-82.75	37.00	BENTHIC	RFPF-B04
68.39-WF1	Virginia	Roaring Fork	-82.76	36.98	BENTHIC	RFPFWF-B01
YCB01	Kentucky	Yocum Creek	-83.19	36.86	BENTHIC	YC-B01
YCB02	Kentucky	Yocum Creek	-83.11	36.85	BENTHIC	YC-B02
YCB03	Kentucky	Yocum Creek	-83.10	36.84	BENTHIC	YC-B03
YCB04	Kentucky	Yocum Creek	-83.10	36.86	BENTHIC	YC-B04

Table A-2. Water Quality Data from Field Sampling Points

SITE ID	Date	CONDUCT	DO	TEMP	PH	Coliforms	*E. Coli*
RF-01	8/20/2012	1020	10	17.39	8.58	8448	100
RF-02	8/20/2012	1040	10	17.33	8.43	8803	306
RF-03	8/20/2012	1020	9.9	16.83	8.41	9331	202
RF-04	8/20/2012	1040	9.9	16.22	8.46	11446	304
RF-05	8/20/2012	1070	9.6	16.67	8.37	8574	100
RF-06	8/20/2012	1090	9.5	17.83	8.45	25950	3405
RF-07	8/20/2012	1100	9.6	17.78	8.44	7541	0
RF-08	8/20/2012	990	9.6	17.44	8.48	43517	3893
RF-09	8/20/2012	1150	9.2	18.78	8.51	17233	202
CC-01	8/20/2012	770	10.2	15.56	8.55	8448	202
CC-02	8/20/2012	770	10.3	15.56	8.52	11236	100
CC-03	8/20/2012	800	10.2	15.17	8.53	8361	409
CC-04	8/20/2012	820	10.3	15.72	8.51	13735	521
CC-05	8/20/2012	810	9.8	14.72	8.54	11370	979
CC-06	8/20/2012	820	10.3	14.50	8.57	12963	960
CC-07	8/20/2012	700	10.2	15.56	8.65	54750	10426
CC-08	8/20/2012	740	10.5	16.39	8.64	38732	6496
CC-09	8/20/2012	1510	8.6	17.89	8.69	17821	1596
CC-10	8/20/2012	560	9.3	16.06	8.32	12229	0
CC-11	8/20/2012	1810	9.1	18.56	8.6	3636	0
CC-12	8/20/2012	830	10.4	15.56	8.59	8296	626
CC-13	8/20/2012	880	9.7	18.11	8.66	9867	852
CC-14	8/20/2012	890	10.4	18.11	8.68	10807	960
CC-15	8/20/2012	930	9.4	17.89	8.33	3684	0
LCVA-01	8/20/2012	790	10.5	14.44	8.48	866	29
LCVA-02	8/20/2012	790	10.5	14.39	8.47	980	28
LCVA-03	8/20/2012	790	10.5	14.39	8.5	1986	21
LCVA-04	8/20/2012	790	10.1	14.28	8.5	1986	18
LCVA-05	8/20/2012	780	10.1	14.11	8.24	727	28
LCVA-06	8/20/2012	750	7.1	13.78	7.3	411	11
LCVA-07	8/20/2012	760	3.7	13.28	7.09	37	0
LCVA-08	8/20/2012	790	9.2	17.28	8.48	866	12
LCKY-01	8/20/2012	640	9.8	17.78	8.67	1986	548
LCKY-02	8/20/2012	292	9.3	19.17	8.72	1986	44
LCKY-03	8/20/2012	286	9.6	19.11	8.7	1733	39
LCKY-04	8/20/2012	285	9.3	17.67	8.33	1300	36
LCKY-05	8/20/2012	284	9.2	17.44	8.41	1203	25
LCKY-06	8/20/2012	224	9.5	16.72	8.15	1203	48
YC-01	8/20/2012	445	9.8	21.72	8.98	12591	1176
YC-02	8/20/2012	459	10	21.72	9.14	24809	1829
YC-03	8/20/2012	460	10.1	19.94	8.87	173289	632

YC-04	8/20/2012	510	8.9	20.72	8.98	129965	1211
YC-05	8/20/2012	530	9.9	19.56	9.02	26025	1336
YC-06	8/20/2012	670	9.7	18.17	9.02	32554	960
YC-07	8/20/2012	680	9.6	17.17	8.64	38732	1336
YC-08	8/20/2012	402	9.5	18.11	8.98	12356	521
RF-01	9/20/2012	890	10.4	14.78	8.51	6907	100
RF-02	9/20/2012	900	10.1	14.72	8.4	7173	100
RF-03	9/20/2012	870	9.9	15.00	8.41	4585	99
RF-04	9/20/2012	970	10.2	14.83	8.46	5653	100
RF-05	9/20/2012	980	10.1	14.72	8.37	3032	99
RF-06	9/20/2012	1020	9.8	15.67	8.43	4638	0
RF-07	9/20/2012	1010	9.7	15.67	8.43	5204	100
RF-08	9/20/2012	570	10.2	15.94	8.37	15152	2917
RF-09	9/20/2012	790	9.7	15.50	8.37	9331	0
CC-01	9/20/2012	660	10.4	14.00	8.42	15001	516
CC-02	9/20/2012	670	10.5	14.00	8.33	13537	413
CC-03	9/20/2012	710	10.3	13.89	8.43	10537	202
CC-04	9/20/2012	720	10.2	14.06	8.44	12963	201
CC-05	9/20/2012	750	9.9	13.50	8.49	57943	2341
CC-06	9/20/2012	730	10.3	13.50	8.49	51721	2745
CC-07	9/20/2012	670	10.3	14.00	8.48	21426	3089
CC-08	9/20/2012	700	9.9	14.39	8.42	23822	5555
CC-09	9/20/2012	1280	8.7	15.50	8.64	23822	2433
CC-10	9/20/2012	610	9.6	14.89	8.17	9317	0
CC-11	9/20/2012	1650	9.2	15.83	8.67	4622	0
CC-12	9/20/2012	750	10.2	13.67	8.5	22818	2135
CC-13	9/20/2012	750	10.1	15.33	8.69	14830	738
CC-14	9/20/2012	780	10.1	15.83	8.64	13135	1890
CC-15	9/20/2012	820	9.6	15.94	8.33	5539	0
LCVA-01	9/20/2012	720	9.6	17.28	8.54	738	100
LCVA-02	9/20/2012	730	9.2	17.39	8.53	304	0
LCVA-03	9/20/2012	740	9.4	17.61	8.51	306	100
LCVA-04	9/20/2012	740	9.5	17.56	8.54	1164	100
LCVA-05	9/20/2012	720	9.5	16.83	8.21	626	100
LCVA-06	9/20/2012	710	8	16.00	7.51	852	202
LCVA-07	9/20/2012	760	3.7	13.28	7.09	0	0
LCVA-08	9/20/2012	650	9.5	16.78	8.49	1613	0
LCKY-01	9/20/2012	430	10	15.28	8.54	1100	413
LCKY-02	9/20/2012	184	9.9	15.33	8.44	14672	413
LCKY-03	9/20/2012	118	10	15.50	8.29	10168	100
LCKY-04	9/20/2012	177	10	15.00	8.27	7894	202
LCKY-05	9/20/2012	175	10	14.89	8.2	11619	99
LCKY-06	9/20/2012	136	10.3	14.56	8.13	7541	100

YC-01	9/20/2012	267	10.5	14.61	8.14	12591	860
YC-02	9/20/2012	271	10.6	14.67	8.35	11983	409
YC-03	9/20/2012	266	10.5	14.28	8.25	18501	2378
YC-04	9/20/2012	317	10.1	14.72	8.28	13540	413
YC-05	9/20/2012	341	10.1	15.22	8.62	13761	409
YC-06	9/20/2012	432	10.3	14.83	8.81	14497	413
YC-07	9/20/2012	500	9.9	15.06	8.58	6053	632
YC-08	9/20/2012	302	10.3	14.83	8.84	12740	738
RF-01	10/18/2012	874	11.5	11.61	8.67	2785	100
RF-02	10/18/2012	888	10.4	11.39	8.34	2590	100
RF-03	10/18/2012	861	10.3	11.33	8.33	1749	306
RF-04	10/18/2012	922	10.3	11.33	8.38	3106	304
RF-05	10/18/2012	936	10.1	11.33	8.3	2230	201
RF-06	10/18/2012	967	10.7	11.06	8.34	3641	0
RF-07	10/18/2012	968	10.3	11.00	8.35	2917	0
RF-08	10/18/2012	675	10.4	10.22	8.21	4321	413
RF-09	10/18/2012	1041	10.8	9.94	8.34	745	0
CC-01	10/18/2012	663	12	10.94	8.56	1211	100
CC-02	10/18/2012	675	11.7	11.00	8.51	1449	202
CC-03	10/18/2012	713	11.2	10.50	8.52	1547	100
CC-04	10/18/2012	723	11.2	10.72	8.51	2785	306
CC-05	10/18/2012	706	11.6	10.17	8.56	7328	2590
CC-06	10/18/2012	702	11.2	10.22	8.56	10460	4434
CC-07	10/18/2012	616	11.4	10.06	8.6	21426	2686
CC-08	10/18/2012	645	11.2	10.61	8.54	23593	8162
CC-09	10/18/2012	1081	9.6	11.67	8.67	241957	852
CC-10	10/18/2012	588	11.1	10.28	8.35	7173	3405
CC-11	10/18/2012	1618	10.2	12.44	8.72	1089	0
CC-12	10/18/2012	711	11.1	10.72	8.57	979	0
CC-13	10/18/2012	787	11.4	12.06	8.76	3454	413
CC-14	10/18/2012	819	12.3	12.50	8.79	11602	9338
CC-15	10/18/2012	883	10.4	13.06	8.43	521	100
LCVA-01	10/18/2012	710	10.1	14.67	8.73	238	36
LCVA-02	10/18/2012	750	9.4	14.61	8.71	201	33
LCVA-03	10/18/2012	760	10.1	14.56	8.66	196	32
LCVA-04	10/18/2012	770	9.9	14.44	8.63	248	40
LCVA-05	10/18/2012	760	9.8	13.94	8.26	155	5
LCVA-06	10/18/2012	730	7.5	13.72	7.43	96	4
LCVA-07	10/18/2012	755	3.6	13.28	7.17	8	0
LCVA-08	10/18/2012	679	10	13.61	8.51	135	4
LCKY-01	10/18/2012	520	10.8	14.22	8.7	2420	921
LCKY-02	10/18/2012	211	10.8	12.89	8.59	980	19
LCKY-03	10/18/2012	208	10.5	12.83	8.36	1986	7

LCKY-04	10/18/2012	204	10.6	12.44	8.31	1986	11
LCKY-05	10/18/2012	202	10.5	12.33	8.29	2420	12
LCKY-06	10/18/2012	164	10.4	12.00	8.09	575	16
YC-01	10/18/2012	339	10.6	12.89	8.56	3498	521
YC-02	10/18/2012	338	10.9	12.78	8.68	8547	1336
YC-03	10/18/2012	336	10.7	12.56	8.66	724	202
YC-04	10/18/2012	385	10.6	12.50	8.7	3267	202
YC-05	10/18/2012	407	10.7	12.67	8.89	51721	20982
YC-06	10/18/2012	570	10.1	12.56	8.99	18600	5940
YC-07	10/18/2012	570	10.6	12.50	8.95	23098	5653
YC-08	10/18/2012	340	10.4	12.50	8.63	409	100
RF-01	11/15/2012	740	12.4	6.00	8.44	1464	0
RF-02	11/15/2012	749	12.3	6.17	8.42	979	0
RF-03	11/15/2012	734	12.6	6.00	8.5	860	0
RF-04	11/15/2012	777	12.4	6.17	8.43	1435	0
RF-05	11/15/2012	795	11.9	6.50	8	979	100
RF-06	11/15/2012	779	13.2	6.50	8.42	2351	304
RF-07	11/15/2012	788	12.1	6.56	8.4	202	0
RF-08	11/15/2012	738	12.7	5.44	8.38	2109	860
RF-09	11/15/2012	869	12.8	5.28	8.46	413	0
CC-01	11/15/2012	509	14.5	5.67	8.72	1849	100
CC-02	11/15/2012	510	14.3	5.61	8.56	5756	0
CC-03	11/15/2012	536	13.2	5.72	8.51	1464	306
CC-04	11/15/2012	535	13.6	6.17	8.58	1199	304
CC-05	11/15/2012	508	13.5	5.67	8.66	860	100
CC-06	11/15/2012	508	13.2	5.67	8.61	18418	16071
CC-07	11/15/2012	434	13.8	5.11	8.68	36540	10394
CC-08	11/15/2012	447	14.1	5.50	8.61	8361	4959
CC-09	11/15/2012	953	12.4	6.94	8.78	2405	1563
CC-10	11/15/2012	408	12.8	5.61	8.42	306	0
CC-11	11/15/2012	1425	11.4	8.17	8.8	521	0
CC-12	11/15/2012	517	13.6	6.06	8.75	3893	2011
CC-13	11/15/2012	600	13	7.67	8.79	8197	202
CC-14	11/15/2012	615	12.7	8.06	8.81	2621	3225
CC-15	11/15/2012	647	12.3	8.50	8.53	202	0
LCVA-01	11/15/2012	589	11.2	10.33	8.77	111	11
LCVA-02	11/15/2012	604	10.8	10.44	8.75	87	11
LCVA-03	11/15/2012	611	10.6	10.83	8.7	129	16
LCVA-04	11/15/2012	644	10.5	11.22	8.68	130	21
LCVA-05	11/15/2012	619	10.9	11.39	8.21	80	12
LCVA-06	11/15/2012	601	9	11.44	7.59	35	0
LCVA-07	11/15/2012	756	4.6	13.28	7.27	12	0
LCVA-08	11/15/2012	421	11.7	8.78	8.6	51	1

LCKY-01	11/15/2012	273	11.8	8.33	8.54	1986	1120
LCKY-02	11/15/2012	168	12.6	7.39	8.46	93	4
LCKY-03	11/15/2012	167	12.6	7.67	8.34	59	1
LCKY-04	11/15/2012	168	12.4	7.39	8.34	57	0
LCKY-05	11/15/2012	172	12.2	7.33	8.27	82	1
LCKY-06	11/15/2012	138	14.2	7.56	8.37	154	2
YC-01	11/15/2012	186	13.2	6.00	8.56	3786	738
YC-02	11/15/2012	193	13.2	6.61	8.64	3641	306
YC-03	11/15/2012	191	13.5	6.11	8.8	1712	0
YC-04	11/15/2012	228	13.3	6.33	8.83	5686	202
YC-05	11/15/2012	251	13.2	6.94	8.97	241957	53353
YC-06	11/15/2012	353	12.9	5.94	9.01	6437	852
YC-07	11/15/2012	355	13.6	6.50	8.96	20142	202
YC-08	11/15/2012	233	12.5	6.83	8.65	413	0
RF-01	12/13/2012	636	15.8	6.17	8.61	306	0
RF-02	12/13/2012	651	12.9	6.56	8.49	413	100
RF-03	12/13/2012	594	12.8	6.17	8.43	306	0
RF-04	12/13/2012	678	12.6	5.94	8.48	306	100
RF-05	12/13/2012	727	12.2	7.17	8.44	306	100
RF-06	12/13/2012	782	11.8	8.00	8.5	306	202
RF-07	12/13/2012	782	11.8	8.00	8.53	100	0
RF-08	12/13/2012	571	12.2	7.56	8.46	202	100
RF-09	12/13/2012	651	12.6	6.61	8.47	202	0
CC-01	12/13/2012	431	8.1	3.72	7.94	632	100
CC-02	12/13/2012	442	11.4	3.94	8.17	745	0
CC-03	12/13/2012	450	11.7	4.33	8.27	632	413
CC-04	12/13/2012	490	12.8	4.56	8.32	1223	100
CC-05	12/13/2012	449	12.6	4.44	8.34	306	0
CC-06	12/13/2012	414	12.5	4.39	8.39	1089	0
CC-07	12/13/2012	335	13.5	2.89	8.38	1464	413
CC-08	12/13/2012	350	13.4	3.17	8.28	1336	100
CC-09	12/13/2012	898	12	5.00	8.62	2133	100
CC-10	12/13/2012	312	15.1	3.44	8.24	0	0
CC-11	12/13/2012	1184	12	5.89	8.8	201	0
CC-12	12/13/2012	413	13.2	4.44	8.56	979	201
CC-13	12/13/2012	555	12.7	5.11	8.55	516	0
CC-14	12/13/2012	581	12.7	5.61	8.6	202	100
CC-15	12/13/2012	640	11.9	6.94	8.45	521	0
LCVA-01	12/13/2012	447	12.5	7.83	8.73	133	6
LCVA-02	12/13/2012	457	12.2	7.89	8.67	190	5
LCVA-03	12/13/2012	469	12.2	8.28	8.62	190	11
LCVA-04	12/13/2012	487	12.1	8.61	8.61	156	10
LCVA-05	12/13/2012	471	11.3	9.06	8.26	101	3

LCVA-06	12/13/2012	471	10.2	9.44	7.66	91	3
LCVA-07	12/13/2012	752	3.9	13.28	7.22	5	0
LCVA-08	12/13/2012	319	12.6	7.06	8.52	218	4
LCKY-01	12/13/2012	275	12.8	6.89	8.45	326	108
LCKY-02	12/13/2012	137	13.3	5.28	8.24	70	4
LCKY-03	12/13/2012	137	13.1	5.67	8.16	83	6
LCKY-04	12/13/2012	135	13	5.39	8.15	96	4
LCKY-05	12/13/2012	135	12.9	5.44	8.06	86	2
LCKY-06	12/13/2012	119	16.1	5.94	8.12	108	4
YC-01	12/13/2012	152	10.7	4.50	7.55	1869	100
YC-02	12/13/2012	156	13.3	5.00	8.06	1731	413
YC-03	12/13/2012	153	13.2	4.78	8.18	632	202
YC-04	12/13/2012	186	13.4	4.44	8.25	2780	304
YC-05	12/13/2012	210	13.1	4.89	8.46	24003	13344
YC-06	12/13/2012	317	13	4.78	8.74	2621	860
YC-07	12/13/2012	318	13.2	4.72	8.76	3405	738
YC-08	12/13/2012	208	19	5.22	8.53	745	0
RF-01	1/11/2013	779	8.9	10.22	8.62	521	100
RF-02	1/11/2013	676	9.4	10.17	8.45	521	304
RF-03	1/11/2013	777	9.6	10.06	8.46	860	516
RF-04	1/11/2013	807	9.6	10.22	8.48	1350	100
RF-05	1/11/2013	828	10.2	10.39	8.34	979	409
RF-06	1/11/2013	845	11.5	10.22	8.42	413	1211
RF-07	1/11/2013	856	10.1	10.17	8.47	0	0
RF-08	1/11/2013	717	11.4	9.78	8.49	3893	1579
RF-09	1/11/2013	820	10.3	9.72	8.54	0	0
CC-01	1/11/2013	542	4.7	9.56	8.24	860	521
CC-02	1/11/2013	544	9	9.61	8.31	738	306
CC-03	1/11/2013	593	9.1	9.72	8.35	521	100
CC-04	1/11/2013	590	9.2	9.78	8.37	860	100
CC-05	1/11/2013	556	9.3	9.89	8.39	1100	745
CC-06	1/11/2013	577	9.2	9.89	8.44	1829	1089
CC-07	1/11/2013	444	9.7	9.06	8.36	6127	4711
CC-08	1/11/2013	256	11.1	8.33	8.15	2281	1323
CC-09	1/11/2013	862	10.2	9.94	8.69	5291	5041
CC-10	1/11/2013	412	10.1	9.11	8.06	0	0
CC-11	1/11/2013	1241	9.1	11.17	8.66	0	0
CC-12	1/11/2013	569	9.9	10.06	8.46	3013	2590
CC-13	1/11/2013	629	10.5	9.83	8.56	516	304
CC-14	1/11/2013	646	10.7	10.06	8.59	852	852
CC-15	1/11/2013	681	10.9	10.11	8.43	0	0
LCVA-01	1/11/2013	622	5.4	12.06	8.91	150	5
LCVA-02	1/11/2013	620	7.2	12.17	8.89	86	3

LCVA-03	1/11/2013	635	7.6	12.22	8.84	128	3
LCVA-04	1/11/2013	654	8.8	12.28	8.76	140	4
LCVA-05	1/11/2013	639	9.1	12.28	8.19	86	1
LCVA-06	1/11/2013	622	8.5	12.17	7.56	34	0
LCVA-07	1/11/2013	735	4.7	13.28	7.27	0	0
LCVA-08	1/11/2013	442	10.4	9.39	8.6	96	0
LCKY-01	1/11/2013	393	7.6	10.50	8.61	6	3
LCKY-02	1/11/2013	199	10	8.17	8.53	78	6
LCKY-03	1/11/2013	193	10.9	8.06	8.39	83	3
LCKY-04	1/11/2013	188	11.3	7.89	8.28	105	3
LCKY-05	1/11/2013	189	11.5	7.89	8.31	96	1
LCKY-06	1/11/2013	161	11	8.11	8.24	105	0
YC-01	1/11/2013	237	8.7	8.39	8.54	17890	1100
YC-02	1/11/2013	254	11.1	8.44	8.65	11123	521
YC-03	1/11/2013	260	10.8	8.33	8.69	4874	202
YC-04	1/11/2013	299	11.1	8.56	8.7	23593	7712
YC-05	1/11/2013	323	11.1	8.83	8.85	9049	1199
YC-06	1/11/2013	404	10.7	8.94	8.98	26125	4479
YC-07	1/11/2013	405	12.5	8.89	8.97	22468	2847
YC-08	1/11/2013	310	10.3	9.44	8.75	0	0
RF-01	2/14/2013	715	10.2	6.83	8.6	202	100
RF-02	2/14/2013	710	9.9	6.72	8.55	100	202
RF-03	2/14/2013	722	9.8	7.06	8.51	201	100
RF-04	2/14/2013	740	11.3	7.28	8.52	413	100
RF-05	2/14/2013	759	10.9	7.72	8.37	413	100
RF-06	2/14/2013	738	10.6	8.67	8.33	306	100
RF-07	2/14/2013	790	11.5	7.33	8.6	0	0
RF-08	2/14/2013	604	11.4	6.67	8.57	2954	626
RF-09	2/14/2013	717	11.6	6.22	8.54	0	0
CC-01	2/14/2013	490	12	6.61	8.64	1100	745
CC-02	2/14/2013	502	12.2	7.00	8.6	960	202
CC-03	2/14/2013	548	12.2	7.00	8.64	1712	201
CC-04	2/14/2013	553	12.3	7.28	8.66	969	413
CC-05	2/14/2013	511	11.2	7.61	8.61	852	516
CC-06	2/14/2013	563	11.9	7.28	8.7	1579	1078
CC-07	2/14/2013	410	12.3	5.67	8.62	3089	2157
CC-08	2/14/2013	315	13.1	5.94	8.49	1089	521
CC-09	2/14/2013	955	11.6	8.11	8.8	5122	632
CC-10	2/14/2013	360	12.5	5.89	8.36	0	0
CC-11	2/14/2013	1475	11.2	10.17	8.83	0	0
CC-12	2/14/2013	567	11.9	8.11	8.66	738	409
CC-13	2/14/2013	601	11.9	8.56	8.75	306	100
CC-14	2/14/2013	624	11.7	8.94	8.74	306	0

CC-15	2/14/2013	658	11.4	8.94	8.54	0	0
LCVA-01	2/14/2013	615	9	10.72	8.92	91	1
LCVA-02	2/14/2013	603	9	10.78	8.88	114	7
LCVA-03	2/14/2013	626	9.8	10.89	8.82	86	5
LCVA-04	2/14/2013	610	9.7	11.00	8.73	260	4
LCVA-05	2/14/2013	613	10.5	11.06	8.16	48	1
LCVA-06	2/14/2013	571	9.4	11.00	7.61	37	0
LCVA-07	2/14/2013	736	6.5	13.22	7.29	2	0
LCVA-08	2/14/2013	368	10.5	7.61	8.52	57	1
LCKY-01	2/14/2013	390	6.5	8.50	8.48	48	5
LCKY-02	2/14/2013	162	10.3	5.33	8.36	77	1
LCKY-03	2/14/2013	158	9.8	5.33	8.17	86	2
LCKY-04	2/14/2013	153	10.5	5.17	7.98	78	0
LCKY-05	2/14/2013	154	11.4	5.17	7.99	119	3
LCKY-06	2/14/2013	131	12	5.22	8.09	127	1
YC-01	2/14/2013	203	4.8	4.94	7.96	5039	632
YC-02	2/14/2013	211	10.7	5.17	8.37	9326	4195
YC-03	2/14/2013	218	11.6	5.06	8.4	3545	202
YC-04	2/14/2013	258	11.5	5.61	8.46	306	100
YC-05	2/14/2013	291	11.3	6.28	8.58	5204	2281
YC-06	2/14/2013	355	11.3	5.89	8.7	969	202
YC-07	2/14/2013	355	11.8	5.83	8.69	1323	202
YC-08	2/14/2013	285	11.1	6.44	8.54	100	0
RF-01	3/21/2013	587	13.8	4.94	8.6	99	99
RF-02	3/21/2013	597	13.8	3.28	8.46	100	0
RF-03	3/21/2013	590	13	1.17	8.41	201	99
RF-04	3/21/2013	618	12.7	5.17	8.42	852	100
RF-05	3/21/2013	636	17.9	5.72	8.32	2307	413
RF-06	3/21/2013	583	12.3	6.67	8.13	2655	738
RF-07	3/21/2013	679	12.6	5.94	8.49	0	0
RF-08	3/21/2013	463	13.1	4.56	8.49	2813	304
RF-09	3/21/2013	552	13	4.56	8.5	0	0
CC-01	3/21/2013	376	14.1	3.44	8.2	306	202
CC-02	3/21/2013	383	13.8	3.72	8.31	306	100
CC-03	3/21/2013	421	11.9	3.83	8.34	745	306
CC-04	3/21/2013	422	7.5	4.17	8.43	10807	304
CC-05	3/21/2013	365	9.8	4.06	8.39	23822	18501
CC-06	3/21/2013	380	10	3.94	8.45	521	413
CC-07	3/21/2013	294	10.3	2.50	8.41	745	100
CC-08	3/21/2013	274	13.7	2.50	8.32	1946	409
CC-09	3/21/2013	477	15.8	4.06	8.59	241957	0
CC-10	3/21/2013	275	13.7	2.67	8.25	0	0
CC-11	3/21/2013	1234	11.2	7.33	8.87	0	0

CC-12	3/21/2013	375	13.1	4.39	8.55	1078	521
CC-13	3/21/2013	489	13.1	5.28	8.56	3839	1731
CC-14	3/21/2013	510	12.8	5.56	8.57	10807	3405
CC-15	3/21/2013	545	13.6	6.39	8.41	0	0
LCVA-01	3/21/2013	488	6	6.00	8.43	72	16
LCVA-02	3/21/2013	492	7.8	6.00	8.44	63	20
LCVA-03	3/21/2013	502	8.5	6.44	8.45	60	4
LCVA-04	3/21/2013	504	8.7	6.83	8.41	47	4
LCVA-05	3/21/2013	507	8.2	8.06	8.01	44	0
LCVA-06	3/21/2013	513	7.5	8.67	7.51	28	0
LCVA-07	3/21/2013	755	3.8	13.22	7.19	1	0
LCVA-08	3/21/2013	322	11.1	5.22	8.25	88	1
LCKY-01	3/21/2013	272	9.4	5.89	8.47	276	23
LCKY-02	3/21/2013	136	10.8	4.00	8.37	150	5
LCKY-03	3/21/2013	136	10.9	3.17	8.15	69	1
LCKY-04	3/21/2013	125	13.1	3.06	7.98	48	0
LCKY-05	3/21/2013	127	13.3	2.94	7.96	56	1
LCKY-06	3/21/2013	119	14.8	2.89	7.87	84	1
YC-01	3/21/2013	145	3.7	3.22	8.08	1596	745
YC-02	3/21/2013	151	9.6	3.33	8.18	7215	2621
YC-03	3/21/2013	156	11.1	3.28	8.3	860	306
YC-04	3/21/2013	186	11.7	3.50	8.4	3734	2433
YC-05	3/21/2013	210	10.7	3.56	8.59	738	0
YC-06	3/21/2013	274	10.5	3.61	8.75	409	0
YC-07	3/21/2013	275	10.4	3.78	8.76	306	0
YC-08	3/21/2013	208	9.7	3.78	8.52	413	0
RF-01	4/25/2013	713	12.5	10.20	7.93	1223	202
RF-02	4/25/2013	725	10.5	10.20	8.44	1350	0
RF-03	4/25/2013	722	10.1	10.30	8.45	1100	0
RF-04	4/25/2013	739	9.9	10.20	8.48	626	0
RF-05	4/25/2013	752	12.4	10.50	8.33	1100	0
RF-06	4/25/2013	677	9.3	11.10	8.12	632	0
RF-07	4/25/2013	836	9.6	10.40	8.61	1350	202
RF-08	4/25/2013	575	9.95	9.50	8.57	4412	306
RF-09	4/25/2013	709	9.65	9.80	8.61	1100	100
CC-01	4/25/2013	484	10.9	9.80	8.72	1211	0
CC-02	4/25/2013	490	9.8	9.80	8.65	2491	202
CC-03	4/25/2013	531	10.7	9.70	8.66	2433	626
CC-04	4/25/2013	537	7.5	10.30	8.72	2751	202
CC-05	4/25/2013	520	8.6	10.10	8.72	3129	3986
CC-06	4/25/2013	522	8.7	10.20	8.71	1731	3451
CC-07	4/25/2013	414	8.8	9.90	8.7	2491	3310
CC-08	4/25/2013	440	10.5	10.20	8.54	4725	2133

CC-09	4/25/2013	853	10.9	11.30	8.74	6907	626
CC-10	4/25/2013	389	10.3	10.10	8.4	860	0
CC-11	4/25/2013	1520	8.9	13.70	8.82	1350	0
CC-12	4/25/2013	514	10.2	11.00	8.73	1449	1211
CC-13	4/25/2013	604	10.1	11.80	8.81	2307	100
CC-14	4/25/2013	617	10.5	11.90	8.8	1989	0
CC-15	4/25/2013	653	10.3	12.20	8.53	304	0
LCVA-01	4/25/2013	678	7.7	15.70	8.77	67	50
LCVA-02	4/25/2013	678	7.8	15.70	8.76	111	68
LCVA-03	4/25/2013	687	8.2	15.30	8.71	121	65
LCVA-04	4/25/2013	694	8.7	15.50	8.64	108	17
LCVA-05	4/25/2013	653	7.8	14.40	8.12	14	1
LCVA-06	4/25/2013	632	6.6	13.90	7.52	7	1
LCVA-07	4/25/2013	757	3.5	13.20	7.26	1	0
LCVA-08	4/25/2013	408	9	13.40	8.58	56	5
LCKY-01	4/25/2013	354	9.8	12.10	8.63	2420	378
LCKY-02	4/25/2013	192	9.2	10.70	8.5	167	7
LCKY-03	4/25/2013	188	9.3	10.80	8.4	147	5
LCKY-04	4/25/2013	184	10.3	10.30	8.31	172	4
LCKY-05	4/25/2013	187	10.4	10.30	8.31	172	3
LCKY-06	4/25/2013	170	11.2	10.10	8.28	194	2
YC-01	4/25/2013	236	6.4	10.10	8.49	10168	738
YC-02	4/25/2013	242	8.6	9.90	8.62	5041	306
YC-03	4/25/2013	250	9.6	10.00	8.69	3319	304
YC-04	4/25/2013	286	9.8	10.30	8.75	13958	1350
YC-05	4/25/2013	308	9.3	10.40	8.83	1660	512
YC-06	4/25/2013	364	9.2	10.10	9	3355	306
YC-07	4/25/2013	365	9.1	10.10	8.96	3641	632
YC-08	4/25/2013	295	8.6	10.10	8.68	844	0
RF-01	5/29/2013	1096	11.2	18.30	8.17	2405	0
RF-02	5/29/2013	1105	7.1	18.20	8.08	1211	0
RF-03	5/29/2013	1099	7.1	18.10	8.05	2182	0
RF-04	5/29/2013	1107	7	17.50	8.08	1323	0
RF-05	5/29/2013	1144	6.8	18.50	7.97	1596	521
RF-06	5/29/2013	1120	6.3	18.40	7.7	3786	979
RF-07	5/29/2013	1227	6.6	20.00	8.04	306	0
RF-08	5/29/2013	979	6.8	19.00	8.12	6367	2109
RF-09	5/29/2013	1148	6.3	20.80	8.12	2281	100
CC-01	5/29/2013	722	7.7	16.20	8.12	1849	100
CC-02	5/29/2013	731	7.7	15.90	8.13	2334	100
CC-03	5/29/2013	726	9.4	15.40	8.11	1890	0
CC-04	5/29/2013	775	7.5	16.00	8.1	3839	201
CC-05	5/29/2013	750	7.3	15.40	8.13	18418	11602

CC-06	5/29/2013	753	7.4	15.20	8.11	12906	8329
CC-07	5/29/2013	451	7.2	16.30	8.15	15967	405
CC-08	5/29/2013	655	7.3	17.00	8.1	12229	632
CC-09	5/29/2013	1608	6	18.10	8.27	17233	1869
CC-10	5/29/2013	507	6.9	16.30	7.91	1712	0
CC-11	5/29/2013	1869	6.5	18.50	8.2	738	0
CC-12	5/29/2013	760	7.2	16.60	8.15	3592	2157
CC-13	5/29/2013	818	7.1	17.20	8.18	1100	0
CC-14	5/29/2013	831	8.1	17.10	8.16	969	306
CC-15	5/29/2013	854	6.9	17.00	7.93	413	0
YC-08	5/29/2013	446	7.5	15.50	8.09	2882	100
YC-07	5/29/2013	595	7.7	15.40	8.31	30759	6701
YC-06	5/29/2013	596	7.8	15.50	8.33	13958	1480
YC-05	5/29/2013	507	7.8	15.80	8.26	10122	1516
YC-04	5/29/2013	485	7.9	16.10	8.2	6314	979
YC-03	5/29/2013	436	8	15.90	8.13	4568	521
LCVA-01	5/29/2013	764	9.4	14.50	8.1	299	91
LCVA-02	5/29/2013	825	7.8	14.60	8.12	248	127
LCVA-03	5/29/2013	856	7.8	14.60	8.12	365	120
LCVA-04	5/29/2013	662	8.7	14.80	8.12	365	72
LCVA-05	5/29/2013	826	7.4	14.60	7.76	108	3
LCVA-06	5/29/2013	762	5.7	14.20	7.27	66	13
LCVA-07	5/29/2013	830	3	13.20	6.85	3	0
LCVA-08	5/29/2013	641	6.9	17.40	8	141	8
LCKY-01	5/29/2013	671	10.1	15.90	8.08	238	12
LCKY-02	5/29/2013	276	7.5	16.30	8.04	2420	17
LCKY-03	5/29/2013	265	7.7	16.00	7.94	1120	13
LCKY-04	5/29/2013	257	7.4	15.50	7.91	1733	12
LCKY-05	5/29/2013	261	7.5	15.70	7.89	1203	11
LCKY-06	5/29/2013	219	7.5	14.30	7.75	2420	7
YC-01	5/29/2013	410	9.1	16.40	7.98	23822	306
YC-02	5/29/2013	421	8.3	16.30	8.1	19179	1435
RF-01	7/22/2013	1047	4.5	18.90	8.11	7439	100
RF-02	7/22/2013	1058	6.6	18.70	8.01	3893	100
RF-03	7/22/2013	1074	6.5	18.90	7.99	4798	100
RF-04	7/22/2013	1093	6.7	18.40	8	5653	0
RF-05	7/22/2013	1111	6.6	18.40	7.9	10537	100
RF-06	7/22/2013	1066	6.4	18.70	7.79	14209	100
RF-07	7/22/2013	1196	6.4	19.20	8.01	2420	12
RF-08	7/22/2013	909	7.5	19.90	8.02	38732	100
RF-09	7/22/2013	1119	6.2	20.10	8.08	2420	6
CC-01	7/22/2013	689	6.9	19.00	8.1	3734	99
CC-02	7/22/2013	705	6.9	18.90	8.09	10807	413

CC-03	7/22/2013	765	7.3	18.40	8.09	13761	202
CC-04	7/22/2013	779	6.7	18.50	8.07	10426	1464
CC-05	7/22/2013	756	6.6	18.10	8.11	16162	632
CC-06	7/22/2013	763	6.7	18.10	8.1	9867	202
CC-07	7/22/2013	667	5	19.60	8.12	10426	1579
CC-08	7/22/2013	604	6	19.60	7.96	7541	409
CC-09	7/22/2013	1101	6.2	19.70	8.2	15286	3069
CC-10	7/22/2013	579	6.3	19.30	7.81	2420	13
CC-11	7/22/2013	1706	6.3	19.50	8.25	727	15
CC-12	7/22/2013	758	6.8	18.30	8.1	13544	521
CC-13	7/22/2013	842	6.4	19.50	8.2	7541	100
CC-14	7/22/2013	845	6.5	19.40	8.2	6504	202
CC-15	7/22/2013	895	6.3	19.20	7.92	2420	12
YC-08	7/22/2013	436	6.1	17.30	8.12	2420	58
YC-07	7/22/2013	612	5.9	18.00	8.31	29093	4654
YC-06	7/22/2013	612	5.4	18.00	8.32	30759	2157
YC-05	7/22/2013	499	5.1	18.20	8.23	23098	3877
YC-04	7/22/2013	471	4.7	18.70	8.13	16640	738
YC-03	7/22/2013	424	4.3	19.00	8.11	16576	860
LCVA-01	7/22/2013	828	4.4	17.70	8.16	387	50
LCVA-02	7/22/2013	851	5.3	17.60	8.14	272	50
LCVA-03	7/22/2013	840	5.2	17.80	8.15	48	38
LCVA-04	7/22/2013	869	4.1	17.40	8.08	517	46
LCVA-05	7/22/2013	827	3.9	16.30	7.7	326	52
LCVA-06	7/22/2013	674	3.7	16.10	7.22	326	36
LCVA-07	7/22/2013	837	3	13.30	6.8	7	0
LCVA-08	7/22/2013	703	3	19.40	8.12	461	28
LCKY-01	7/22/2013	352	3.2	17.70	8.11	1733	48
LCKY-02	7/22/2013	274	3.9	18.90	8.02	2420	34
LCKY-03	7/22/2013	267	4.2	18.60	7.97	2420	51
LCKY-04	7/22/2013	259	4.6	18.10	7.83	2420	34
LCKY-05	7/22/2013	258	4.7	18.10	7.85	2420	38
LCKY-06	7/22/2013	259	5	18.20	7.85	2420	42
YC-01	7/22/2013	406	1.9	18.90	7.95	34480	201
YC-02	7/22/2013	417	3.8	19.40	8.08	38732	9594
RF-01	6/24/2013	1045	7.3	17.40	7.95	15227	4874
RF-02	6/24/2013	1046	7.2	17.10	7.97	17934	3451
RF-03	6/24/2013	1050	7.2	17.10	7.97	17934	5461
RF-04	6/24/2013	1068	7.3	16.80	7.99	30759	5371
RF-05	6/24/2013	1079	7.1	16.70	7.9	16502	17247
RF-06	6/24/2013	979	6.7	16.70	7.72	18719	7712
RF-07	6/24/2013	1105	7	17.20	7.99	15152	201
RF-08	6/24/2013	966	6.9	16.90	8.02	241957	20459

RF-09	6/24/2013	1079	7	17.20	8.04	26025	201
CC-01	6/24/2013	711	9.8	17.30	8.12	22468	1480
CC-02	6/24/2013	719	7.5	17.30	8.09	17934	3451
CC-03	6/24/2013	755	7.4	17.00	8.08	30759	6437
CC-04	6/24/2013	759	7.2	17.20	8.07	22468	3277
CC-05	6/24/2013	661	7	17.10	8.11	29093	7173
CC-06	6/24/2013	727	7.1	17.10	8.1	26125	6198
CC-07	6/24/2013	666	6.8	18.20	8.11	241957	61314
CC-08	6/24/2013	646	6.5	18.30	7.96	46111	16071
CC-09	6/24/2013	1172	6.5	18.50	8.17	61314	13327
CC-10	6/24/2013	597	6.8	17.90	7.78	17934	306
CC-11	6/24/2013	1919	6.6	18.80	8.17	11685	0
CC-12	6/24/2013	732	11.4	17.40	8.08	34480	5291
CC-13	6/24/2013	799	7.2	17.30	8.13	26125	1869
CC-14	6/24/2013	809	7.2	17.40	8.11	20459	3361
CC-15	6/24/2013	843	6.9	17.30	7.82	11004	100
YC-08	6/24/2013	354	7.3	16.60	7.99	6815	99
YC-07	6/24/2013	546	7.5	17.30	8.23	46111	11300
YC-06	6/24/2013	546	7.2	17.40	8.23	41602	16695
YC-05	6/24/2013	430	7.1	17.40	8.13	15386	1829
YC-04	6/24/2013	418	7	17.90	8.08	12657	2011
YC-03	6/24/2013	318	7	17.90	8.03	12103	852
LCVA-01	6/24/2013	842	7.7	18.10	8.28	387	150
LCVA-02	6/24/2013	846	7.4	18.10	8.24	435	29
LCVA-03	6/24/2013	833	7.4	18.20	8.22	649	22
LCVA-04	6/24/2013	866	7.4	18.10	8.19	345	8
LCVA-05	6/24/2013	818	7.3	16.60	7.75	162	6
LCVA-06	6/24/2013	768	5.8	15.80	7.16	387	3
LCVA-07	6/24/2013	852	3.5	13.30	6.86	5	0
LCVA-08	6/24/2013	578	6.8	18.60	8.04	291	5
LCKY-01	6/24/2013	552	4.6	17.10	8.08	914	43
LCKY-02	6/24/2013	280	4.5	17.60	8.07	2420	10
LCKY-03	6/24/2013	272	4.8	17.50	7.99	1986	33
LCKY-04	6/24/2013	262	5.2	16.70	7.85	1986	10
LCKY-05	6/24/2013	266	5.9	16.90	7.89	1733	13
LCKY-06	6/24/2013	234	6.6	15.50	7.74	2420	15
YC-01	6/24/2013	376	5.6	18.90	7.96	17853	1089
YC-02	6/24/2013	381	6.9	18.60	8.12	20459	2133
RF-01	8/19/2013	1151	2.9	19.00	8.2	8448	100
RF-02	8/19/2013	1170	4.3	18.90	8.09	8803	306
RF-03	8/19/2013	1182	4.7	18.90	8.07	9331	202
RF-04	8/19/2013	1197	5.8	18.60	8.09	11446	304
RF-05	8/19/2013	1023	5.1	18.60	8.01	8574	100

RF-06	8/19/2013	1045	5.4	17.90	7.72	25950	3405
RF-07	8/19/2013	1259	5.2	19.60	8.01	7541	0
RF-08	8/19/2013	1113	5.4	19.60	8.11	43517	3893
RF-09	8/19/2013	1285	5.3	20.30	8.11	17233	202
CC-01	8/19/2013	832	5	18.30	8.14	8448	202
CC-02	8/19/2013	840	5.1	18.00	8.13	11236	100
CC-03	8/19/2013	886	5.7	17.70	8.13	8361	409
CC-04	8/19/2013	898	5.8	17.60	8.09	13735	521
CC-05	8/19/2013	907	6.1	17.10	8.16	11370	979
CC-06	8/19/2013	910	6.3	17.20	8.15	12963	960
CC-07	8/19/2013	828	5.9	18.60	8.2	54750	10426
CC-08	8/19/2013	885	7.4	18.70	8.15	38732	6496
CC-09	8/19/2013	1299	6.3	18.50	8.21	17821	1596
CC-10	8/19/2013	731	6.5	18.30	7.81	12229	0
CC-11	8/19/2013	1762	6.6	18.20	8.27	3636	0
CC-12	8/19/2013	917	6.7	17.50	8.19	8296	626
CC-13	8/19/2013	924	8.9	18.40	8.18	9867	852
CC-14	8/19/2013	935	6.8	18.10	8.18	10807	960
CC-15	8/19/2013	968	6.6	17.90	7.91	3684	0
YC-08	8/19/2013	457	3.8	17.20	8.1	12356	521
YC-07	8/19/2013	667	3.6	17.30	8.39	38732	1336
YC-06	8/19/2013	660	3.6	17.50	8.37	32554	960
YC-05	8/19/2013	546	2.9	17.60	8.29	26025	1336
YC-04	8/19/2013	520	2.7	18.10	8.13	129965	1211
YC-03	8/19/2013	473	2.6	18.30	8.12	173289	632
LCVA-01	8/19/2013	892	1.8	15.90	7.99	866	29
LCVA-02	8/19/2013	887	4.2	15.80	8.09	980	28
LCVA-03	8/19/2013	892	4.3	15.80	8.08	1986	21
LCVA-04	8/19/2013	903	4.5	15.70	8.03	1986	18
LCVA-05	8/19/2013	861	4.8	15.00	7.72	727	28
LCVA-06	8/19/2013	821	4.6	14.90	7.16	411	11
LCVA-07	8/19/2013	852	4	13.30	6.84	37	0
LCVA-08	8/19/2013	742	4.7	18.10	8.02	866	12
LCKY-01	8/19/2013	665	2.2	16.80	8.17	1986	548
LCKY-02	8/19/2013	276	2.8	17.70	7.97	1986	44
LCKY-03	8/19/2013	270	3.1	17.40	7.9	1733	39
LCKY-04	8/19/2013	269	3.3	16.90	7.77	1300	36
LCKY-05	8/19/2013	268	3.6	16.80	7.77	1203	25
LCKY-06	8/19/2013	267	3.6	18.60	7.75	1203	48
YC-01	8/19/2013	453	1.5	19.20	7.83	12591	1176
YC-02	8/19/2013	461	2.3	18.90	8.08	24809	1829
RF-01	9/25/2013	1124	6.8	15.70	8.15	11528	0
RF-02	9/25/2013	1130	1.6	15.60	7.8	12236	100

RF-03	9/25/2013	1147	4.3	15.70	7.99	12740	0
RF-04	9/25/2013	1174	4.6	15.60	8.07	12740	0
RF-05	9/25/2013	1190	4.9	15.50	8	11004	202
RF-06	9/25/2013	1093	5.3	15.20	7.78	13327	100
RF-07	9/25/2013	1222	5.3	15.90	7.98	6828	100
RF-08	9/25/2013	1136	5.5	15.80	8.08	21872	2405
RF-09	9/25/2013	1184	5.7	16.20	8.11	8841	0
CC-01	9/25/2013	833	6.4	15.90	8.19	21872	626
CC-02	9/25/2013	844	6.5	15.70	8.15	22468	738
CC-03	9/25/2013	887	6.6	15.70	8.15	22468	202
CC-04	9/25/2013	903	6.7	15.80	8.12	21872	202
CC-05	9/25/2013	876	6.9	15.20	8.16	16242	620
CC-06	9/25/2013	877	6.9	15.20	8.15	22468	632
CC-07	9/25/2013	755	6.7	15.80	8.17	30759	1449
CC-08	9/25/2013	754	7.1	15.80	8.08	22236	2281
CC-09	9/25/2013	811	6.7	15.80	8.06	57943	1890
CC-10	9/25/2013	708	9.6	15.60	7.89	18418	202
CC-11	9/25/2013	1577	6.6	16.70	8.36	11123	0
CC-12	9/25/2013	872	6.9	15.40	8.13	14672	413
CC-13	9/25/2013	934	6.8	16.80	8.19	32554	23593
CC-14	9/25/2013	955	6.7	17.00	8.19	13169	201
CC-15	9/25/2013	981	6.6	17.20	8.01	5573	0
LCVA-01	9/25/2013	900	4.8	15.40	8.25	435	42
LCVA-02	9/25/2013	903	5.1	15.30	8.2	381	31
LCVA-03	9/25/2013	920	5.5	15.30	8.18	816	34
LCVA-04	9/25/2013	919	5.8	15.10	8.18	461	32
LCVA-05	9/25/2013	895	6.1	14.40	7.93	326	45
LCVA-06	9/25/2013	851	5.6	14.00	7.19	210	18
LCVA-07	9/25/2013	864	4.6	13.30	6.93	72	0
LCVA-08	9/25/2013	867	5.7	16.60	8.04	416	34
LCKY-01	9/25/2013	590	3.2	16.30	8.17	2420	225
LCKY-02	9/25/2013	250	3.5	16.30	7.97	2420	44
LCKY-03	9/25/2013	242	4.6	16.10	7.85	2420	58
LCKY-04	9/25/2013	243	5	15.80	7.77	2420	58
LCKY-05	9/25/2013	242	5.4	16.00	7.84	0	44
LCKY-06	9/25/2013	195	6.6	14.90	7.62	1986	17
YC-01	9/25/2013	515	1.8	17.50	8.09	20142	632
YC-02	9/25/2013	531	2.8	17.20	8.19	14497	632
YC-03	9/25/2013	559	3.1	16.90	8.26	16071	306
YC-04	9/25/2013	426	3.5	16.60	8.32	16640	409
YC-05	9/25/2013	617	4.3	16.40	8.43	77010	5708
YC-06	9/25/2013	733	4.6	16.10	8.52	14672	860
YC-07	9/25/2013	761	4.9	16.00	8.52	155312	16162

YC-08	9/25/2013	526	5.5	15.90	8.25	5940	100
RF-01	10/23/2013	1054	6	10.70	8.22	2621	745
RF-02	10/23/2013	1067	6.6	10.70	8.06	4257	1579
RF-03	10/23/2013	1064	7.2	10.40	8.04	2281	521
RF-04	10/23/2013	1092	4.9	10.20	8.11	2530	413
RF-05	10/23/2013	1109	7.4	10.60	8.01	2133	
RF-06	10/23/2013	970	7.4	11.20	7.82	3145	1310
RF-07	10/23/2013	1116	7.9	10.60	8.05	1989	0
RF-08	10/23/2013	978	8.3	10.00	8.07	16242	9594
RF-09	10/23/2013	1086	10	9.80	8.12	745	0
CC-01	10/23/2013	700	6.3	10.20	8.18	4135	306
CC-02	10/23/2013	799	6.4	10.30	8.04	5208	201
CC-03	10/23/2013	826	6.6	10.30	8.11	4103	409
CC-04	10/23/2013	830	7.8	10.40	8.08	5633	413
CC-05	10/23/2013	808	6.6	10.40	8.13	8392	3051
CC-06	10/23/2013	784	6.7	10.40	8.13	2917	745
CC-07	10/23/2013	675	8.8	10.00	8.15	20142	7976
CC-08	10/23/2013	678	4.5	10.10	8.08	30759	3893
CC-09	10/23/2013	689	7.7	10.30	8.07	19349	2462
CC-10	10/23/2013	652	4.9	10.10	7.93	1869	0
CC-11	10/23/2013	1426	6.6	11.60	8.42	1890	0
CC-12	10/23/2013	806	8.4	10.50	8.09	12356	4711
CC-13	10/23/2013	845	8.5	10.70	8.23	12657	1613
CC-14	10/23/2013	859	8.4	11.00	8.27	19179	969
CC-15	10/23/2013	907	7.3	11.80	8.03	3267	0
LCVA-01	10/23/2013	811	2	10.50	7.83	161	11
LCVA-02	10/23/2013	819	4.3	10.60	8.07	272	24
LCVA-03	10/23/2013	833	5.3	10.80	8.12	344	21
LCVA-04	10/23/2013	849	5.4	11.10	8.11	436	16
LCVA-05	10/23/2013	848	5.3	12.30	7.91	250	17
LCVA-06	10/23/2013	860	4.3	13.00	7.13	93	0
LCVA-07	10/23/2013	868	3.6	13.30	6.94	22	0
LCVA-08	10/23/2013	863	5.8	10.60	7.98	361	36
LCKY-01	10/23/2013	799	5.1	12.30	8.43	1986	1733
LCKY-02	10/23/2013	277	7.4	7.40	8.23	1300	15
LCKY-03	10/23/2013	207	7.6	7.40	8.07	921	34
LCKY-04	10/23/2013	270	7.8	7.40	7.92	613	3
LCKY-05	10/23/2013	271	7.9	7.40	7.91	479	4
LCKY-06	10/23/2013	269	8.1	7.20	7.95	387	8
YC-01	10/23/2013	454	6.2	7.00	7.8	4954	745
YC-02	10/23/2013	471	10.5	7.10	8.3	3184	745
YC-03	10/23/2013	451	11.7	6.80	8.42	2954	409
YC-04	10/23/2013	509	12.8	6.70	8.48	3145	620

YC-05	10/23/2013	551	12	7.70	8.59	4568	306
YC-06	10/23/2013	538	11	7.10	8.68	173289	409
YC-07	10/23/2013	660	10.3	7.00	8.68	111987	860
YC-08	10/23/2013	451	12.9	7.50	8.34	738	0
RF-01	11/13/2013	885	7.3	4.60	8.33	1464	0
RF-02	11/13/2013	903	6.1	5.10	8.12	979	0
RF-03	11/13/2013	904	6.1	5.10	8.12	860	0
RF-04	11/13/2013	916	7.7	4.40	8.11	1435	0
RF-05	11/13/2013	937	6.6	4.80	7.97	979	100
RF-06	11/13/2013	911	6	6.80	7.85	2351	304
RF-07	11/13/2013	804	6.6	6.20	8.02	202	0
RF-08	11/13/2013	890	6.5	6.70	8.21	2109	860
RF-09	11/13/2013	959	7.1	5.30	8.1	413	0
CC-01	11/13/2013	627	6.6	2.70	8.3	1849	100
CC-02	11/13/2013	649	6.5	3.60	8.23	5756	0
CC-03	11/13/2013	658	6.6	3.40	8.23	1464	306
CC-04	11/13/2013	706	6.3	4.40	8.27	1199	304
CC-05	11/13/2013	683	6.6	4.30	8.31	860	100
CC-06	11/13/2013	672	6.8	4.10	8.31	18418	16071
CC-07	11/13/2013	560	8.8	2.90	8.35	36540	10394
CC-08	11/13/2013	568	7.6	3.20	8.27	8361	4959
CC-09	11/13/2013	566	7.8	3.60	8.21	2405	1563
CC-10	11/13/2013	524	7.7	2.80	8	306	0
CC-11	11/13/2013	1257	6.4	6.40	8.46	521	0
CC-12	11/13/2013	691	8	5.10	8.29	3893	2011
CC-13	11/13/2013	702	7.6	4.50	8.3	8197	202
CC-14	11/13/2013	755	7.1	6.00	8.26	2621	3225
CC-15	11/13/2013	824	6.5	8.10	8.14	202	0
LCVA-01	11/13/2013	675	2.4	4.00	8.22	111	11
LCVA-02	11/13/2013	659	4.6	4.40	8.33	87	11
LCVA-03	11/13/2013	715	5	5.30	8.34	129	16
LCVA-04	11/13/2013	702	4.9	6.40	8.34	130	21
LCVA-05	11/13/2013	798	4.3	9.80	8.15	80	12
LCVA-06	11/13/2013	843	3.3	12.50	7.33	35	0
LCVA-07	11/13/2013	870	2.5	13.20	7.05	12	0
LCVA-08	11/13/2013	628	6.1	3.80	8.17	51	1
LCKY-01	11/13/2013	641	3.2	9.30	8.32	1986	1120
LCKY-02	11/13/2013	202	5	2.70	8.15	93	4
LCKY-03	11/13/2013	200	4.7	3.70	7.95	59	1
LCKY-04	11/13/2013	204	5.1	3.40	7.82	57	0
LCKY-05	11/13/2013	204	5.1	3.40	7.75	82	1
LCKY-06	11/13/2013	192	5.3	3.40	7.75	154	2
YC-01	11/13/2013	354	3.6	1.50	7.63	3786	738

YC-02	11/13/2013	373	5	1.90	7.98	3641	306
YC-03	11/13/2013	390	5.6	1.60	8.23	1712	0
YC-04	11/13/2013	431	5.5	1.40	8.23	5686	202
YC-05	11/13/2013	480	5	3.50	8.44	241957	53353
YC-06	11/13/2013	561	5.4	2.50	8.43	6437	852
YC-07	11/13/2013	583	5.4	2.40	8.53	4434	202
YC-08	11/13/2013	376	5.4	3.20	8.22	413	0
RF-01	12/12/2013	662	14.8	0.00	7.85	306	0
RF-02	12/12/2013	675	15.9	6.20	7.61	413	100
RF-03	12/12/2013	682	11.9	6.20	7.69	306	0
RF-04	12/12/2013	723	14.8	6.40	7.72	306	100
RF-05	12/12/2013	752	13.6	7.20	7.67	306	100
RF-06	12/12/2013	690	12.9	7.40	7.58	306	202
RF-07	12/12/2013	780	12.4	7.70	7.77	100	0
RF-08	12/12/2013	682	11.6	7.40	7.83	202	100
RF-09	12/12/2013	769	12.3	7.50	7.84	202	0
CC-01	12/12/2013	442	14.7	5.90	7.61	632	100
CC-02	12/12/2013	447	14.7	5.90	7.59	745	0
CC-03	12/12/2013	484	13.4	6.00	7.66	632	413
CC-04	12/12/2013	487	13.8	6.20	7.67	1223	100
CC-05	12/12/2013	437	12.5	5.70	7.65	306	0
CC-06	12/12/2013	441	12.2	5.60	7.68	1089	0
CC-07	12/12/2013	414	13.4	5.00	7.6	1464	413
CC-08	12/12/2013	362	17.3	5.10	7.51	1336	100
CC-09	12/12/2013	901	12.4	6.70	8.1	2133	100
CC-10	12/12/2013	370	10.4	4.90	7.4	0	0
CC-11	12/12/2013	1502	14.3	9.20	8.11	201	0
CC-12	12/12/2013	438	14.8	6.00	7.65	979	201
CC-13	12/12/2013	552	15.1	6.90	7.81	516	0
CC-14	12/12/2013	576	12.7	7.20	7.77	202	100
CC-15	12/12/2013	604	14.7	7.60	7.6	521	0
LCVA-01	12/12/2013	508	12.8	7.30	7.53	133	6
LCVA-02	12/12/2013	510	16.7	7.40	7.62	190	5
LCVA-03	12/12/2013	516	16.9	7.50	7.62	190	11
LCVA-04	12/12/2013	541	16.8	7.70	7.63	156	10
LCVA-05	12/12/2013	529	15.2	8.50	7.22	101	3
LCVA-06	12/12/2013	522	18.6	8.50	6.73	91	3
LCVA-07	12/12/2013	883	9.7	13.30	6.35	5	0
LCVA-08	12/12/2013	385	19.2	6.60	7.66	218	4
LCKY-01	12/12/2013	288	16.7	5.40	7.68	326	108
LCKY-02	12/12/2013	173	17.7	3.40	7.46	70	4
LCKY-03	12/12/2013	171	20.1	3.70	7.25	83	6
LCKY-04	12/12/2013	173	20.5	3.60	7.11	96	4

LCKY-05	12/12/2013	172	20.4	3.80	7.1	86	2
LCKY-06	12/12/2013	176	20.6	3.60	7.16	108	4
YC-01	12/12/2013	179	17.4	2.20	7.26	1869	100
YC-02	12/12/2013	184	17.6	2.20	7.29	1731	413
YC-03	12/12/2013	184	18.6	2.50	7.4	632	202
YC-04	12/12/2013	203	17.5	2.50	7.27	2780	304
YC-05	12/12/2013	226	19.5	2.70	7.61	24003	13344
YC-06	12/12/2013	314	17.3	2.80	7.85	2621	860
YC-07	12/12/2013	322	15.7	2.80	7.83	3405	738
YC-08	12/12/2013	199	19.5	4.00	7.65	745	0
RF-01	1/16/2014	647	13.2	5.30	7.95	185	23
RF-02	1/16/2014	659	15.1	5.60	7.9	201	55
RF-03	1/16/2014	664	14.3	5.50	7.73	148	33
RF-04	1/16/2014	695	14.2	5.90	7.76	172	32
RF-05	1/16/2014	719	14.8	6.60	7.67	3931	3361
RF-06	1/16/2014	631	13.7	8.10	7.36	6086	5731
RF-07	1/16/2014	776	15.6	6.60	7.84	133	32
RF-08	1/16/2014	580	14.8	6.40	7.94	1579	1323
RF-09	1/16/2014	686	14.3	6.40	7.97	140	0
CC-01	1/16/2014	409	13.8	4.50	7.66	3498	738
CC-02	1/16/2014	415	14.3	4.60	7.66	409	0
CC-03	1/16/2014	461	14.2	4.90	7.79	345	80
CC-04	1/16/2014	460	14.6	5.00	7.86	727	101
CC-05	1/16/2014	413	15.6	4.50	7.83	738	201
CC-06	1/16/2014	414	15.3	4.50	7.84	1199	306
CC-07	1/16/2014	314	16.6	3.10	7.68	860	521
CC-08	1/16/2014	276	13.1	3.30	7.65	306	202
CC-09	1/16/2014	829	14.6	3.90	8.03	1089	201
CC-10	1/16/2014	291	15.8	3.20	7.48	172	99
CC-11	1/16/2014	1381	13.5	6.90	8.15	409	1
CC-12	1/16/2014	417	15.1	5.00	7.92	1211	99
CC-13	1/16/2014	523	15.5	6.10	7.82	454	78
CC-14	1/16/2014	551	15.1	6.50	7.93	1712	409
CC-15	1/16/2014	592	14.8	7.20	7.79	93	1
LCVA-01	1/16/2014	492	14.5	6.50	7.94	138	2
LCVA-02	1/16/2014	496	15.6	6.60	7.93	162	4
LCVA-03	1/16/2014	506	15.4	6.90	7.89	144	4
LCVA-04	1/16/2014	523	15.3	7.10	7.86	387	8
LCVA-05	1/16/2014	519	14.8	8.20	7.53	22	1
LCVA-06	1/16/2014	444	13.2	7.10	7.21	127	0
LCVA-07	1/16/2014	801	10.6	13.20	6.64	8	0
LCVA-08	1/16/2014	333	13.6	5.10	7.63	308	0
LCKY-01	1/16/2014	322	18.4	6.40	7.9	313	108

LCKY-02	1/16/2014	156	18	3.80	7.54	112	0
LCKY-03	1/16/2014	152	15.4	3.90	7.6	119	1
LCKY-04	1/16/2014	151	18.3	3.70	7.58	122	1
LCKY-05	1/16/2014	151	18.5	3.70	7.34	142	1
LCKY-06	1/16/2014	152	18.6	3.50	7.15	138	3
YC-01	1/16/2014	180	12.5	4.00	7.96	2307	202
YC-02	1/16/2014	185	13.5	3.90	7.55	3405	738
YC-03	1/16/2014	190	15.6	4.00	7.33	1100	100
YC-04	1/16/2014	223	15.6	4.00	7.37	2070	201
YC-05	1/16/2014	250	13.7	4.40	7.69	413	100
YC-06	1/16/2014	330	14.9	4.30	7.95	405	201
YC-07	1/16/2014	331	13.9	4.30	8.01	632	202
YC-08	1/16/2014	241	17.3	5.30	7.94	202	100
RF-01	2/21/2014	518	10.9	9.50	7.99	184	28
RF-02	2/21/2014	531	10.3	9.60	7.79	231	36
RF-03	2/21/2014	535	10.2	9.60	7.8	516	100
RF-04	2/21/2014	553	10	9.80	7.72	979	100
RF-05	2/21/2014	567	10	10.30	7.68	202	202
RF-06	2/21/2014	410	9.9	10.40	7.69	308	56
RF-07	2/21/2014	694	10	10.50	7.88	131	16
RF-08	2/21/2014	360	10.3	9.90	7.91	121	25
RF-09	2/21/2014	416	10.2	10.00	7.82	186	8
CC-01	2/21/2014	328	10.6	8.40	7.57	738	201
CC-02	2/21/2014	323	10.9	8.40	7.58	626	100
CC-03	2/21/2014	344	10.6	8.40	7.68	860	202
CC-04	2/21/2014	340	10.6	8.40	7.65	866	96
CC-05	2/21/2014	259	10.7	7.80	7.69	770	72
CC-06	2/21/2014	254	10.8	7.80	7.64	313	33
CC-07	2/21/2014	222	10.8	7.60	7.67	219	46
CC-08	2/21/2014	194	10.7	7.80	7.68	304	201
CC-09	2/21/2014	213	10.7	7.70	7.8	388	14
CC-10	2/21/2014	211	10.8	7.70	8.52	816	10
CC-11	2/21/2014	1025	9.6	12.10	7.91	727	6
CC-12	2/21/2014	261	10.8	8.20	7.82	738	100
CC-13	2/21/2014	398	10.4	9.30	7.69	921	28
CC-14	2/21/2014	429	10.4	9.40	7.7	276	9
CC-15	2/21/2014	454	10.3	9.50	7.73	248	8
LCVA-01	2/21/2014	383	10.7	8.80	8.06	1046	46
LCVA-02	2/21/2014	385	10.5	8.80	7.79	1120	32
LCVA-03	2/21/2014	387	7.3	8.90	7.76	548	9
LCVA-04	2/21/2014	400	10.6	8.90	7.64	548	6
LCVA-05	2/21/2014	360	10.4	9.00	7.37	461	9
LCVA-06	2/21/2014	389	10	8.80	7.23	435	4

LCVA-07	2/21/2014	825	3.4	13.20	6.72	0	0
LCVA-08	2/21/2014	250	10.8	7.80	7.69	488	6
LCKY-01	2/21/2014	202	12.1	7.00	7.96	249	17
LCKY-02	2/21/2014	124	11.8	6.20	8.03	99	3
LCKY-03	2/21/2014	122	11.7	6.20	7.51	133	3
LCKY-04	2/21/2014	123	11.7	6.10	7.67	130	1
LCKY-05	2/21/2014	123	11.5	6.30	7.69	122	1
LCKY-06	2/21/2014	125	11.5	6.10	7.4	120	1
YC-01	2/21/2014	115	13.1	5.10	7.89	1596	100
YC-02	2/21/2014	120	12.2	5.20	7.63	844	100
YC-03	2/21/2014	122	12.2	5.20	7.32	626	100
YC-04	2/21/2014	148	11.9	5.50	7.23	1890	202
YC-05	2/21/2014	169	11.8	5.80	7.47	626	100
YC-06	2/21/2014	243	11.8	5.70	7.57	409	202
YC-07	2/21/2014	243	11.7	5.70	7.71	521	100
YC-08	2/21/2014	165	11.6	6.20	7.78	738	100
RF-01	3/28/2014	786	10.2	10.10	8.29	626	100
RF-02	3/28/2014	828	9.6	10.10	8.04	413	202
RF-03	3/28/2014	818	9.7	10.00	7.91	516	100
RF-04	3/28/2014	849	9.7	10.20	7.86	100	100
RF-05	3/28/2014	865	9.6	10.20	7.82	100	100
RF-06	3/28/2014	685	8.8	10.80	7.76	306	100
RF-07	3/28/2014	950	9.7	9.90	7.78	219	0
RF-08	3/28/2014	641	10.1	8.90	7.89	521	100
RF-09	3/28/2014	784	10.1	8.90	7.84	63	2
CC-01	3/28/2014	550	10.5	9.00	7.93	521	100
CC-02	3/28/2014	554	10.4	9.00	7.96	979	306
CC-03	3/28/2014	598	10.4	9.20	7.97	731	405
CC-04	3/28/2014	599	10.5	9.30	8.04	2882	1089
CC-05	3/28/2014	578	10.2	9.80	8.11	3986	3310
CC-06	3/28/2014	578	10.3	9.80	8.1	4165	3546
CC-07	3/28/2014	389	11.3	8.30	8.35	3684	1089
CC-08	3/28/2014	420	11.1	8.40	8.25	2255	738
CC-09	3/28/2014	435	10.9	8.50	8.51	3089	202
CC-10	3/28/2014	345	10.8	8.20	8.21	236	8
CC-11	3/28/2014	1387	9.5	10.40	7.81	291	0
CC-12	3/28/2014	506	10.2	10.00	8.23	2751	1211
CC-13	3/28/2014	634	10.6	9.70	8.22	1211	516
CC-14	3/28/2014	650	10.5	9.90	8.22	1089	852
CC-15	3/28/2014	685	10	10.00	8.15	75	5
LCVA-01	3/28/2014	696	10	10.60	8.47	219	8
LCVA-02	3/28/2014	699	9.9	10.70	8.33	308	14
LCVA-03	3/28/2014	718	9.9	10.80	8.24	178	10

LCVA-04	3/28/2014	665	9.8	11.00	8.12	153	4
LCVA-05	3/28/2014	695	9.4	11.50	8.01	93	1
LCVA-06	3/28/2014	673	7.7	11.60	7.72	62	1
LCVA-07	3/28/2014	825	3.7	13.20	7.24	8	0
LCVA-08	3/28/2014	447	10	9.10	7.86	70	1
LCKY-01	3/28/2014	518	10.1	11.60	8.2	1300	2420
LCKY-02	3/28/2014	214	10.4	9.00	8.06	205	19
LCKY-03	3/28/2014	205	10.6	8.80	8.04	148	5
LCKY-04	3/28/2014	196	10.7	8.50	7.97	122	2
LCKY-05	3/28/2014	196	10.6	8.50	7.87	135	3
LCKY-06	3/28/2014	197	10.7	8.40	7.9	145	0
YC-01	3/28/2014	286	11.1	9.50	8.3	1089	306
YC-02	3/28/2014	295	10.7	9.50	8.09	8823	521
YC-03	3/28/2014	300	10.4	9.60	8.1	3170	306
YC-04	3/28/2014	345	10.2	10.00	8.07	3184	1323
YC-05	3/28/2014	367	10.2	10.30	8.13	4455	1089
YC-06	3/28/2014	458	10.2	10.00	8.22	2559	1350
YC-07	3/28/2014	459	10.1	10.00	8.29	3051	852
YC-08	3/28/2014	300	10.2	9.80	8.29	2157	100
RF-01	4/11/2014	801	10.5	11.50	8.19	413	100
RF-02	4/11/2014	816	10.3	11.70	8.08	413	100
RF-03	4/11/2014	776	9.9	12.00	8.05	202	100
RF-04	4/11/2014	847	9.9	12.00	8.01	409	100
RF-05	4/11/2014	862	9.7	12.20	8.04	731	100
RF-06	4/11/2014	701	9.2	12.90	7.67	1223	100
RF-07	4/11/2014	963	9.7	12.70	7.85	435	1
RF-08	4/11/2014	619	9.8	12.50	8.07	860	201
RF-09	4/11/2014	762	9.6	12.60	8.07	980	3
CC-01	4/11/2014	564	10.6	14.50	8.46	306	100
CC-02	4/11/2014	570	9.9	14.00	8.19	632	100
CC-03	4/11/2014	617	9.8	13.90	8.16	632	100
CC-04	4/11/2014	625	9.3	14.90	8.2	521	100
CC-05	4/11/2014	506	9.7	14.00	8.19	1350	413
CC-06	4/11/2014	544	9.7	14.00	8.16	413	100
CC-07	4/11/2014	397	9.7	14.10	8.25	2433	1199
CC-08	4/11/2014	398	9.3	14.70	8.4	98039	2882
CC-09	4/11/2014	762	8.7	14.90	8.44	979	304
CC-10	4/11/2014	352	9.3	14.00	8.19	133	1
CC-11	4/11/2014	155	9.3	16.20	7.97	230	0
CC-12	4/11/2014	511	9.2	14.80	8.05	1223	413
CC-13	4/11/2014	681	9.5	14.90	8.19	1350	100
CC-14	4/11/2014	687	9.6	14.80	8.24	1100	202
CC-15	4/11/2014	728	9.1	14.50	8.07	154	0

LCVA-01	4/11/2014	622	10.3	11.40	8.56	45	3
LCVA-02	4/11/2014	611	10.2	11.50	8.4	32	3
LCVA-03	4/11/2014	636	10.6	11.60	8.28	28	2
LCVA-04	4/11/2014	670	10	11.80	8.17	82	36
LCVA-05	4/11/2014	624	9.6	12.00	8.04	40	17
LCVA-06	4/11/2014	623	7.9	12.10	7.63	84	5
LCVA-07	4/11/2014	834	4	13.20	7.2	1	0
LCVA-08	4/11/2014	382	9.8	11.00	8.16	161	10
LCKY-01	4/11/2014	472	10.3	13.00	8.22	1986	2420
LCKY-02	4/11/2014	218	10.2	11.50	8.43	186	9
LCKY-03	4/11/2014	208	10	11.60	8.08	201	0
LCKY-04	4/11/2014	206	10	11.30	7.98	179	3
LCKY-05	4/11/2014	206	10.1	11.40	7.86	133	0
LCKY-06	4/11/2014	209	10.1	11.40	7.75	105	0
YC-01	4/11/2014	250	11.1	10.80	8.46	1989	100
YC-02	4/11/2014	259	10.7	10.90	8.17	4638	100
YC-03	4/11/2014	268	10.4	10.90	8.08	4135	201
YC-04	4/11/2014	300	10.4	11.30	7.97	2917	1449
YC-05	4/11/2014	341	10.6	11.30	8.11	26125	26125
YC-06	4/11/2014	438	10.5	10.90	8.22	19349	6367
YC-07	4/11/2014	413	10.4	10.90	8.25	15525	6053
YC-08	4/11/2014	306	10.1	11.20	8.22	738	100
RF-01	5/15/2014	905	8.2	17.30	7.8	11190	100
RF-02	5/15/2014	877	8	17.20	7.93	9049	100
RF-03	5/15/2014	897	8	17.30	7.94	11123	100
RF-04	5/15/2014	927	8.2	16.90	7.96	9599	306
RF-05	5/15/2014	950	8.1	16.70	7.88	15525	409
RF-06	5/15/2014	767	8	16.30	7.78	16071	2482
RF-07	5/15/2014	1019	8.6	16.60	7.89	4549	0
RF-08	5/15/2014	733	8	16.70	7.97	2420	2420
RF-09	5/15/2014	824	8.2	17.60	7.99	2420	457
CC-01	5/15/2014	509	8.2	17.10	7.87	19559	2847
CC-02	5/15/2014	504	8.5	16.90	7.82	13958	1223
CC-03	5/15/2014	539	8.4	16.40	7.82	15525	632
CC-04	5/15/2014	560	8.5	16.20	7.82	9895	632
CC-05	5/15/2014	493	8.4	16.40	7.86	22468	2133
CC-06	5/15/2014	487	8.5	16.30	7.86	10918	1100
CC-07	5/15/2014	405	8.2	16.70	7.92	11718	860
CC-08	5/15/2014	407	8.4	16.70	7.88	7491	1211
CC-09	5/15/2014	933	7.8	17.10	8.16	36540	2462
CC-10	5/15/2014	352	8.4	16.60	7.92	2420	63
CC-11	5/15/2014	1676	7.7	17.60	7.76	649	13
CC-12	5/15/2014	492	8.4	16.20	8.21	20459	10758

CC-13	5/15/2014	620	8.7	15.70	8.02	5461	738
CC-14	5/15/2014	627	8.7	15.60	8	4622	202
CC-15	5/15/2014	643	8.8	15.50	7.91	1733	156
LCVA-01	5/15/2014	739	8.5	16.40	8.26	387	84
LCVA-02	5/15/2014	739	8.3	16.30	8.07	488	93
LCVA-03	5/15/2014	759	8.5	16.30	8.04	517	88
LCVA-04	5/15/2014	779	8.5	16.40	8.02	461	58
LCVA-05	5/15/2014	735	8.4	16.30	7.86	387	72
LCVA-06	5/15/2014	740	7.2	16.20	7.62	387	30
LCVA-07	5/15/2014	845	3.8	13.30	7.31	3	0
LCVA-08	5/15/2014	642	7.8	18.60	7.77	548	42
LCKY-01	5/15/2014	358	10.5	12.60	8.26	687	27
LCKY-02	5/15/2014	176	10	11.30	8.22	613	62
LCKY-03	5/15/2014	169	10.1	11.00	7.99	579	54
LCKY-04	5/15/2014	164	10	10.80	7.95	479	62
LCKY-05	5/15/2014	162	9.7	10.80	7.82	689	49
LCKY-06	5/15/2014	166	9.8	10.80	7.82	1300	60
YC-01	5/15/2014	273	10.2	12.50	8.88	3310	306
YC-02	5/15/2014	276	10	12.40	8.33	12591	1869
YC-03	5/15/2014	281	9	12.10	8.18	10918	2334
YC-04	5/15/2014	313	9.8	12.40	8.09	10497	4044
YC-05	5/15/2014	323	9.9	12.00	8.08	21426	14012
YC-06	5/15/2014	442	9.9	11.80	8.14	9322	632
YC-07	5/15/2014	438	9.8	11.80	8.22	13761	2011
YC-08	5/15/2014	264	9.9	11.30	8.28	15152	745
RF-01	6/17/2014	1137	8.2	21.10	8.03	9063	0
RF-02	6/17/2014	1110	8.4	20.30	8.11	5555	100
RF-03	6/17/2014	1070	8.2	20.10	8.12	6015	100
RF-04	6/17/2014	1134	8.2	19.30	8.09	5833	202
RF-05	6/17/2014	1187	8	20.30	8.03	9086	100
RF-06	6/17/2014	871	8.1	19.30	7.92	12229	306
RF-07	6/17/2014	1331	7.8	22.30	8	961	2
RF-08	6/17/2014	907	7.7	21.60	8.1	15525	100
RF-09	6/17/2014	1145	7.3	23.80	7.98	961	5
CC-01	6/17/2014	817	8.6	18.90	8.08	5756	100
CC-02	6/17/2014	747	9	18.50	8.14	6496	516
CC-03	6/17/2014	767	9	17.70	8.21	6437	201
CC-04	6/17/2014	849	8.7	17.80	8.08	8782	100
CC-05	6/17/2014	810	8.7	17.10	8.13	10758	620
CC-06	6/17/2014	828	8.6	16.90	8.08	12498	306
CC-07	6/17/2014	719	8.4	18.40	8.24	14672	2086
CC-08	6/17/2014	781	8.7	19.20	8.14	18600	521
CC-09	6/17/2014	1918	7.8	19.70	8.23	96061	304

CC-10	6/17/2014	527	8.1	18.10	8	2420	8
CC-11	6/17/2014	2011	7.4	20.00	7.88	236	2
CC-12	6/17/2014	842	8.8	18.20	8.42	12103	413
CC-13	6/17/2014	891	8.5	19.70	8.21	10460	100
CC-14	6/17/2014	827	8.5	19.50	8.2	5555	100
CC-15	6/17/2014	961	8	19.50	8.08	770	4
LCVA-01	6/17/2014	891	9.2	16.30	8.36	166	12
LCVA-02	6/17/2014	888	8.9	16.20	8.08	270	16
LCVA-03	6/17/2014	900	8.8	16.00	8.01	228	12
LCVA-04	6/17/2014	922	9	15.90	8.07	178	26
LCVA-05	6/17/2014	865	9.1	14.80	8	114	2
LCVA-06	6/17/2014	843	6.5	14.20	7.81	61	1
LCVA-07	6/17/2014	851	3.8	13.30	7.46	3	0
LCVA-08	6/17/2014	748	7.7	19.50	7.87	328	4
LCKY-01	6/17/2014	668	8.7	17.00	8.06	649	22
LCKY-02	6/17/2014	296	8.9	18.50	8.24	1011	70
LCKY-03	6/17/2014	286	8.6	18.30	8.18	961	34
LCKY-04	6/17/2014	270	8.5	17.70	8.06	2420	50
LCKY-05	6/17/2014	269	8.5	17.70	8.15	2420	37
LCKY-06	6/17/2014	271	8.5	17.80	8.06	1553	46
YC-01	6/17/2014	506	8.4	19.90	8.46	32554	738
YC-02	6/17/2014	521	8.4	19.50	8.17	26125	632
YC-03	6/17/2014	534	8.3	18.80	8.16	26125	1089
YC-04	6/17/2014	554	8.6	18.50	8.19	13761	860
YC-05	6/17/2014	573	8.7	17.90	8.21	14137	860
YC-06	6/17/2014	689	8.8	18.00	8.29	111987	2847
YC-07	6/17/2014	683	8.7	17.90	8.36	77010	6053
YC-08	6/17/2014	493	8.4	17.60	8.16	816	183
RF-01	7/21/2014	891	9	18.50	8.05	7439	100
RF-02	7/21/2014	908	8.7	18.50	8.08	3893	100
RF-03	7/21/2014	916	8.6	18.40	8.07	4798	100
RF-04	7/21/2014	965	8.4	18.00	8.04	5653	0
RF-05	7/21/2014	989	8.5	18.60	8.01	10537	100
RF-06	7/21/2014	810	7.9	18.70	7.99	14209	100
RF-07	7/21/2014	1073	8.4	19.10	8.03	2420	12
RF-08	7/21/2014	782	8.1	19.50	8.1	38732	100
RF-09	7/21/2014	929	8.1	20.40	8.06	2420	6
CC-01	7/21/2014	553	9.1	17.40	7.86	3734	99
CC-02	7/21/2014	560	9.3	17.20	7.96	10807	413
CC-03	7/21/2014	588	9.1	16.90	8	13761	202
CC-04	7/21/2014	580	9.1	16.90	8.02	10426	1464
CC-05	7/21/2014	481	9	16.60	8.03	16162	632
CC-06	7/21/2014	482	9	16.60	7.94	9867	202

CC-07	7/21/2014	408	9	17.20	8.06	10426	1579
CC-08	7/21/2014	400	8.9	17.30	7.98	7541	409
CC-09	7/21/2014	514	8.8	17.50	8.34	15286	3069
CC-10	7/21/2014	327	8.8	17.10	7.97	2420	13
CC-11	7/21/2014	1805	8.4	18.60	7.86	727	15
CC-12	7/21/2014	495	8.9	17.20	8.16	13544	521
CC-13	7/21/2014	680	8.9	18.10	8.11	7541	100
CC-14	7/21/2014	713	8.9	18.10	8.08	6504	202
CC-15	7/21/2014	782	8.8	18.30	7.98	2420	12
LCVA-01	7/21/2014	625	9.2	16.30	8.33	387	50
LCVA-02	7/21/2014	626	9	16.20	7.94	272	50
LCVA-03	7/21/2014	631	9.1	16.20	7.85	48	38
LCVA-04	7/21/2014	643	9.1	16.20	7.89	517	46
LCVA-05	7/21/2014	611	9	15.80	7.72	326	52
LCVA-06	7/21/2014	594	8.2	15.80	7.51	326	36
LCVA-07	7/21/2014	846	4.4	13.30	7.24	7	0
LCVA-08	7/21/2014	484	9.1	16.10	7.78	461	28
LCKY-01	7/21/2014	312	9.1	16.80	7.87	1733	48
LCKY-02	7/21/2014	198	9.1	16.90	8.07	2420	34
LCKY-03	7/21/2014	197	9.1	16.60	8.05	2420	51
LCKY-04	7/21/2014	198	9.2	16.20	7.76	2420	34
LCKY-05	7/21/2014	196	9.1	16.20	7.81	2420	38
LCKY-06	7/21/2014	201	9	16.30	7.64	2420	42
YC-01	7/21/2014	258	9	18.30	8.34	34480	201
YC-02	7/21/2014	261	8.9	18.10	7.96	38732	9594
YC-03	7/21/2014	259	8.8	17.90	7.94	16576	860
YC-04	7/21/2014	287	8.7	17.90	7.8	16640	738
YC-05	7/21/2014	300	8.9	17.60	7.87	23098	3877
YC-06	7/21/2014	397	8.9	17.70	7.96	30759	2157
YC-07	7/21/2014	433	8.8	17.80	8.01	29093	4654
YC-08	7/21/2014	250	9.1	16.50	8.04	2420	58
RF-01	8/12/2014	655	8	19.40	8.01	155312	3267
RF-02	8/12/2014	664	8	19.30	8.06	32554	413
RF-03	8/12/2014	712	8	19.20	8.02	30759	860
RF-04	8/12/2014	720	8.2	18.90	7.99	23593	852
RF-05	8/12/2014	777	8.1	19.50	7.86	24809	306
RF-06	8/12/2014	584	7.9	19.10	7.93	16576	202
RF-07	8/12/2014	874	8	19.80	7.95	2420	228
RF-08	8/12/2014	531	8	19.30	7.98	26125	413
RF-09	8/12/2014	623	8.1	19.70	7.98	2420	80
CC-01	8/12/2014	471	8.2	19.00	8.06	36540	2334
CC-02	8/12/2014	527	8.2	19.10	8.04	61314	1323
CC-03	8/12/2014	562	8.3	19.00	8.08	43517	1967

CC-04	8/12/2014	532	8.3	18.90	8.05	46111	731
CC-05	8/12/2014	473	8.2	19.50	8.06	38732	304
CC-06	8/12/2014	471	8.1	19.40	8.03	38732	738
CC-07	8/12/2014	410	8.2	19.70	8.05	23593	507
CC-08	8/12/2014	420	8.2	19.80	8.07	21426	1613
CC-09	8/12/2014	415	8.1	19.70	8.16	22818	409
CC-10	8/12/2014	398	8	19.70	7.93	2420	260
CC-11	8/12/2014	1012	7.4	20.80	7.96	2420	613
CC-12	8/12/2014	476	8.1	19.60	8	17890	413
CC-13	8/12/2014	548	8.4	18.70	8.03	20982	1596
CC-14	8/12/2014	588	8.5	18.50	7.98	20459	1211
CC-15	8/12/2014	688	8.1	18.80	7.93	2420	210
LCVA-01	8/12/2014	830	9.2	16.00	8.51	980	39
LCVA-02	8/12/2014	867	9.2	16.00	8.26	727	21
LCVA-03	8/12/2014	882	9.2	15.90	8.1	435	32
LCVA-04	8/12/2014	872	9.2	15.80	8.1	579	20
LCVA-05	8/12/2014	857	8.9	15.50	7.92	291	20
LCVA-06	8/12/2014	845	7.1	15.40	7.83	345	13
LCVA-07	8/12/2014	839	4.2	13.40	7.64	5	0
LCVA-08	8/12/2014	950	8.2	20.00	7.97	411	16
LCKY-01	8/12/2014	596	9.1	16.30	8.16	1300	17
LCKY-02	8/12/2014	273	8.8	16.70	8.29	1733	69
LCKY-03	8/12/2014	265	9	16.50	8.15	2420	54
LCKY-04	8/12/2014	252	8.7	16.20	8.08	1986	70
LCKY-05	8/12/2014	252	8.9	16.20	8.03	1553	42
LCKY-06	8/12/2014	249	8.9	16.30	8.02	1733	50
YC-01	8/12/2014	421	8.8	18.40	8.52	18719	745
YC-02	8/12/2014	433	8.8	18.00	8.16	57943	2405
YC-03	8/12/2014	444	9	17.30	8.09	23822	852
YC-04	8/12/2014	479	8.9	16.90	8.11	13958	745
YC-05	8/12/2014	507	9.2	16.60	8.71	20459	731
YC-06	8/12/2014	617	9.2	16.60	8.33	24890	2133
YC-07	8/12/2014	618	9.2	16.60	8.38	24809	306
YC-08	8/12/2014	440	8.9	16.10	8.29	1967	0

Table A-3. ICP-MS ion concentrations and lab-determined carbonate concentrations

SITE ID	Date	ZN	AS	SE	NA	MG	AL	SI	P	S	CL	K	CA	CR	FE	MN	CO	NI	CU	HCO3
LCKY-01	8/21/12	2.8	0	0	124300	9936	5.4	3097	47.1	86590	5891	3625	26520	1.59	108.4	27.4	0	0.47	0.22	0
LCKY-02	8/21/12	2.72	0	0	26370	8318	29.1	2270	18.1	59140	4210	2240	21590	6.49	67.7	3.6	0	0.57	0.59	0
LCKY-03	8/21/12	2.46	0	0	25120	7994	34.8	2321	15.1	58630	4057	2152	20230	0.62	23.4	2.9	0	0.42	0	0
LCKY-04	8/21/12	2.37	0	0	25490	8384	23.3	2368	11.2	67130	4437	2216	19690	0.48	14.9	1.6	0	0.42	0	0
LCKY-05	8/21/12	2.41	0	0	25380	8433	28	2307	14	68320	4730	2272	19870	0.43	17.6	1.5	0	0.5	0	0
LCKY-06	8/21/12	2.67	0	0	24190	6015	32	2200	14.8	38760	11970	1690	11470	0.32	18.1	0.9	0	0.3	0	0
YC-01	8/21/12	2.65	0	0	60950	8978	23.7	1996	17.5	58990	4243	3091	24080	1.08	31.6	2.8	0.06	0.55	0.49	0
YC-02	8/21/12	2.68	0	0	64880	9083	33.9	2182	21.6	59360	4319	3089	23760	1.08	37.2	3.3	0.05	0.51	0.53	0
YC-03	8/21/12	2.61	0	0	69930	9036	39.2	2658	23.3	59100	3010	3014	23120	1.2	40	3.7	0	0.53	0.31	0
YC-04	8/21/12	2.57	0	0	80990	9279	48.4	2646	19.7	65320	3029	3132	23800	1.56	39.6	4.5	0.05	0.51	0.29	0
YC-05	8/21/12	2.46	0	0	88180	9385	72.9	2892	25.6	66290	2762	3134	23770	1.26	44.9	3.5	0.05	0.45	0.29	0
YC-06	8/21/12	2.75	0	0	139000	8887	93.7	3203	6.9	79500	3125	3122	23410	1.9	60.7	3.2	0.06	0.47	0.23	0
YC-07	8/21/12	2.64	0	0	138500	8846	88.7	3160	34.2	78750	2946	3067	23400	1.77	53.2	3.7	0.05	0.49	0.21	0
YC-08	8/21/12	2.81	0	0	36300	14910	59.5	2951	12.6	87620	247	3860	35250	0.96	27.1	1.3	0.06	0.66	0	0
CC-01	8/22/12	2.85	0.68	0	66410	36990	17.5	2552	0	332900	2657	5770	81120	1.12	85.7	14.5	0.17	1.87	0.39	0
CC-02	8/22/12	2.97	0	0	66530	36750	20.1	2562	0	330200	2339	5736	80460	1.13	82.6	19	0.18	1.73	0.37	0
CC-03	8/22/12	2.87	0	0	70600	38770	20.3	2600	0	355000	2124	5909	84140	1.2	61.6	13.4	0.14	1.77	0.28	0
CC-04	8/22/12	2.84	0	0	77710	35010	19.2	2506	0	335600	1909	5921	79060	1.17	55.4	8.5	0.12	1.73	0.34	0
CC-05	8/22/12	4.09	0	0	95130	31850	14.6	3217	77.6	312100	5353	5442	71580	1.41	281.4	10.7	0.14	1.63	0.34	0
CC-06	8/22/12	3.17	0	0	97590	33470	11.3	2922	0	327500	3430	5265	73720	1.35	53.9	6.5	0.1	1.64	0.39	0
CC-07	8/22/12	3.49	0	0	98560	20010	15.6	3034	0	243900	4618	4499	55280	1.26	99	15.3	0.12	1.21	0.41	0
CC-08	8/22/12	3.31	0	0	103600	20040	18.6	3081	0	249100	4978	4522	54980	1.25	119.1	24.5	0.11	1.24	0.48	0
CC-09	8/22/12	3.41	0	0	372800	20720	11.5	3106	0	570800	8858	7099	45850	2.9	28.2	6.1	0.14	0.98	0.36	0
CC-10	8/22/12	3.43	0	0	50530	20870	19.1	3254	0	196500	3978	3983	58030	0.89	153.3	55.6	0.15	1.45	0.31	0
CC-11	8/22/12	2.66	0	0	414500	21480	7.2	3114	0	616000	9247	7493	46440	3.03	0	1.2	0.13	1.03	0	0
CC-12	8/22/12	3.79	0	0	98100	35030	10.9	3085	0	332500	3349	5498	75430	1.4	41.9	7.5	0.11	1.63	0.28	0
CC-13	8/22/12	3.44	0	0	60180	42440	29.6	2374	15.8	392400	558	7092	91190	1.08	40.7	6.9	0.12	2.37	0.21	0
CC-14	8/22/12	3.76	0	0	62020	43380	29.6	2378	11.7	400500	423	7319	92060	2.56	37.1	6	0.13	2.61	0.26	0
CC-15	8/22/12	4.95	0	0	63690	44190	32.3	2480	10.7	412600	249	7414	98080	1.07	47.6	19.6	0.17	3.09	0.18	0
LCVA-01	8/22/12	3.38	0	0	87040	34790	9.2	3143	0	263900	4373	4320	70490	1.35	42	11.6	0.08	1.11	0	0
LCVA-02	8/22/12	3.33	0	0	88500	35260	7.3	3203	20.4	262800	4334	4418	71240	1.45	35.8	9.7	0.08	1.16	0	0
LCVA-03	8/22/12	3.2	0	0	88780	35440	8.3	3179	0	261600	4248	4462	71790	1.52	28.6	8.7	0.07	1.15	0	0

LCVA-04	8/22/12	3.43	0	0	90870	33340	9	3173	0	254400	4491	4354	69930	1.37	31.8	11	0.06	1.15	0	0
LCVA-05	8/22/12	3.65	0	0	97080	30980	6.6	3331	0	241600	4566	4270	68370	1.51	19.5	34.6	0.06	1.2	0	0
LCVA-06	8/22/12	3.52	0	0	102000	27400	2.6	3396	0	211500	4709	4104	61440	1.81	28.8	154.8	0.05	0.89	0	0
LCVA-07	8/22/12	3.12	0	0	111500	26230	0.2	3687	0	196600	3640	4108	59360	2.04	32.9	194.6	0	0.83	0	0
LCVA-08	8/22/12	2.92	0	0	64140	34680	16.1	2579	10.2	286400	8375	4555	73670	1.11	57.8	36.1	0.1	1.21	0.13	0
RF-01	8/22/12	3.51	0	0	78140	54920	21.1	2778	0	453200	1268	6316	101800	1.3	121.8	53.1	0.27	2.32	0.18	0
RF-02	8/22/12	3.69	0	0	77660	54750	17.9	2795	16.5	440900	1197	6363	102800	1.3	117.6	69	0.29	2.38	0.17	0
RF-03	8/22/12	1.47	0	0	68740	56940	19.6	2623	15.8	458000	915	6397	108100	1.21	73.1	59.9	0.34	2.72	0.14	0
RF-04	8/22/12	1.28	0	0	72800	57700	19.7	2575	19	475500	942	6617	112800	1.14	75.5	59	0.3	2.69	0.23	0
RF-05	8/22/12	1.77	0	0	73430	58310	19.4	2600	19.2	484500	862	6645	114300	1.95	78.9	71	0.32	2.87	0.23	0
RF-06	8/22/12	1.12	0	0	57970	64390	17.8	2410	17.2	513300	415	6467	120500	1.11	89.4	87	0.33	2.6	0.2	0
RF-07	8/22/12	0.97	0	0	57740	63990	18.8	2393	19.5	513800	394	6379	119800	1.08	88	86.6	0.33	2.58	0.13	0
RF-08	8/22/12	1.48	0	0	92060	41220	50.1	2871	12	456100	1340	6122	91560	0.89	73.5	95	0.62	2.56	0	0
RF-09	8/22/12	1.65	0	0	101300	47290	76.9	2703	8.9	533000	1201	6921	106600	0.93	89.8	166.8	1.23	3.57	0.13	0
LCKY-01	9/20/12	0	0	0	72310	7128	43.8	2336	0	62460	6202	2609	20340	0.7	146.9	28	0.07	6.14	0.11	0
LCKY-02	9/20/12	0	0	0	16410	5620	46.9	2047	0	42260	4700	1766	15870	0.08	75.7	5.4	0.06	0.22	0	0
LCKY-03	9/20/12	0	0	0	15800	5504	51.5	1996	0	42530	4556	1738	15330	0.86	83.8	5.9	0.09	0.2	0.51	0
LCKY-04	9/20/12	0	0	0	15240	5704	68.1	1940	0	43450	4475	1719	14730	0.09	125.7	8.4	0.1	0.23	0	0
LCKY-05	9/20/12	0	0	0	14740	5674	52.2	1902	0	43880	4658	1731	14700	0.07	95.3	6.4	0.07	0.22	0	0
LCKY-06	9/20/12	0	0	0	12730	4402	196.1	1917	0	26120	8227	1364	10480	0.24	349.4	23.8	0.33	0.45	0.22	0
LCVA-01	9/20/12	0	0	0	54950	29950	46.6	2497	0	252100	5454	4116	62660	0.05	137.6	26.8	0.13	0.67	0	0
LCVA-02	9/20/12	0	0	0	54770	29720	23.4	2437	0	251700	5350	4095	62510	0.21	73.2	12.8	0.07	0.63	0	0
LCVA-03	9/20/12	0	0	0	54750	29470	37.2	2545	0	249000	5349	4073	62570	0.06	109.8	26.1	0.12	0.67	0	0
LCVA-04	9/20/12	0	0	0	57620	29750	55.7	2453	0	253800	5248	4133	63730	0.07	162.7	39.4	0.14	0.77	0	0
LCVA-05	9/20/12	0	0	0	60360	28420	47	2370	0	245800	5317	4084	62230	0.06	129.4	47.4	0.12	0.77	0	0
LCVA-06	9/20/12	0	0	0	66800	26600	36.4	2397	0	231000	5512	3968	59050	0.05	91.8	85.9	0.08	0.56	0	0
LCVA-07	9/20/12	0	0	0	96850	23300	0	2793	0	195700	4494	3716	54040	0	18.5	179.1	0	0.27	0	0
LCVA-08	9/20/12	0	0	0	39200	30390	37.9	1950	0	270200	5340	4282	64280	0.05	104.8	23	0.13	0.86	0	0
YC-01	9/20/12	0	0	0	28780	7640	14.1	2681	0	47340	4884	2562	21970	0.06	24.8	1.2	0	0.26	0	0
YC-02	9/20/12	0	0	0	29870	7741	15.8	2636	0	47630	4658	2549	21770	0	24.8	1.5	0	0.24	0	0
YC-03	9/20/12	0	0	0	32610	7343	17	2636	0	45370	3822	2438	19620	0.05	24.7	1.4	0	0.2	0	0
YC-04	9/20/12	0	0	0	41830	7924	67.8	2485	0	53330	3561	2588	21290	0.1	113.1	10.3	0.12	0.31	0	0
YC-05	9/20/12	0	0	0	51800	7367	103.9	2446	0	51790	2879	2426	19290	0.13	165.4	10.3	0.16	0.36	0	0
YC-06	9/20/12	0	0	0	74170	8211	142.9	2442	0	65670	2903	2652	21960	0.19	225.9	13.2	0.2	0.47	0.14	0

YC-07	9/20/12	0	0	0	92620	8727	31.1	2380	0	76260	3055	2811	23740	0.06	34.2	1.7	0	0.16	0	0
YC-08	9/20/12	0	0	0	24520	10640	128	2504	0	63470	919	2904	25460	0.14	211.1	10.6	0.23	0.56	0	0
CC-01	9/21/12	0	0.73	0	49390	29720	11.7	2301	0	286000	3972	5063	66360	0	62	10.3	0.08	1	0.1	0
CC-02	9/21/12	0	0.36	0	50860	30110	13.5	2308	0	292700	3581	5103	67500	0	63.7	16.4	0.13	1.02	0	0
CC-03	9/21/12	0	0	0	56890	31930	6.7	2248	0	319900	3285	5258	70240	0	29.7	7	0.07	1.09	0	0
CC-04	9/21/12	0	0	0	64190	29130	9.5	2227	0	308600	3313	5407	68200	0	36.7	5.4	0.08	1.09	0	0
CC-05	9/21/12	0	0	0	80910	26840	11.4	2551	0	305800	5005	4547	60980	0	60.3	4.5	0.08	0.88	0	0
CC-06	9/21/12	0	0	0	82520	27390	7.3	2481	0	313500	4595	4586	61790	0	26.5	3.6	0.1	0.98	0	0
CC-07	9/21/12	0	0	0	89010	18020	10.1	2727	0	264300	6238	4097	49830	0	47.3	4.8	0.1	0.84	0.1	0
CC-08	9/21/12	0	0	0	94340	18510	11.1	2777	0	277900	6308	4222	51260	3.94	81.4	9.4	0.12	0.96	0.26	0
CC-09	9/21/12	0	0	0	178000	18020	8.4	2346	0	413200	7635	4918	47160	0	26.2	10	0.1	0.71	0	0
CC-10	9/21/12	0	0	0	68090	19310	6.5	2844	0	247900	5436	3970	52820	0	40.9	42	0.1	0.91	0	0
CC-11	9/21/12	0	0	0	285700	18180	8.8	2021	0	586600	9106	6028	41540	0	0	1.4	0.1	0.57	0	0
CC-12	9/21/12	0	0	0	82320	28300	6.9	2545	0	316800	4713	4650	63200	0	27.2	3.8	0.07	0.83	0	0
CC-13	9/21/12	0	0	0	44320	35190	24.8	1944	0	339200	1738	6625	82190	0	64.2	9.2	0.11	1.64	0	0
CC-14	9/21/12	0	0	0	46360	35590	23.6	1904	0	345000	1596	6687	82660	0	58.9	9.8	0.11	1.67	0	0
CC-15	9/21/12	0	0	0	47150	37420	13.3	1862	0	365900	1248	7061	86990	0	44.9	12.2	0.11	2.26	0	0
RF-01	9/21/12	0	0	0	58560	46230	19.8	2110	0	417900	1706	5464	86490	0	104.4	39.2	0.19	1.26	0	0
RF-02	9/21/12	0	0	0	59380	47460	16.2	2136	0	429200	1634	5549	88820	0	103.4	55.7	0.21	1.35	0	0
RF-03	9/21/12	0	0	0	50880	49050	9.9	2005	0	432200	1387	5537	92660	0	50.4	44.4	0.21	1.39	0	0
RF-04	9/21/12	0	0	0	55280	52220	6.7	1973	0	477200	1480	5803	101500	0	50.1	49.7	0.21	1.54	0	0
RF-05	9/21/12	0	0	0	56930	53240	16.4	2007	0	490200	1389	5915	103800	0	89.8	66.3	0.26	1.64	0	0
RF-06	9/21/12	0	0	0	49360	57320	41.5	1945	0	529700	823	5767	108600	0	190.7	90.1	0.34	1.49	0	0
RF-07	9/21/12	0	0	0	49090	56820	21.2	1895	0	524000	725	5699	107400	0	116.2	80.8	0.26	1.42	0	0
RF-08	9/21/12	0	0	0	41280	23270	12.6	2362	0	218000	3024	3766	54150	0	105.1	36.8	0.12	0.9	0	0
RF-09	9/21/12	0	0	0	49360	35500	30.4	2290	0	383400	2155	4778	83950	0	139.1	243.7	0.54	2.48	0	0
LCKY-01	10/18/12	0	0	0	91680	8170	14.5	2197	8.7	75430	6729	3061	22460	0	122.1	31.1	0	0.11	0	0
LCKY-02	10/18/12	0	0	0	19770	7162	14	1838	0	56030	5125	2178	19200	0	23.1	3.2	0	0.11	0	0
LCKY-03	10/18/12	0	0	0	19010	7109	12.2	1830	0	56100	5159	2132	18730	0	18.8	3.1	0	0.1	0	0
LCKY-04	10/18/12	0	0	0	18970	7089	10.1	1854	0	55700	5173	2133	18600	0	16.4	2.8	0	0.14	0	0
LCKY-05	10/18/12	0	0	0	17980	7148	13.5	1811	0	58090	5245	2131	18460	0.37	23.5	4.1	0	0.13	0	0
LCKY-06	10/18/12	0	0	0	18000	5522	120.8	1826	0	36230	10000	1609	12760	0.11	196.9	16.6	0.19	0.24	0	0
LCVA-01	10/18/12	0	0	0	72090	30190	15.1	2446	0	254600	5241	4049	61800	0	72.5	21.3	0.06	0.52	0	0
LCVA-02	10/18/12	0	0	0	73260	30660	15.6	2489	0	257900	5304	4104	63310	0	70	18.7	0.05	0.52	0	0

LCVA-03	10/18/12	0	0	0	74710	31230	20.5	2524	0	262600	5341	4146	64910	0	82.1	25	0.07	0.51	0	0
LCVA-04	10/18/12	0	0	0	75790	31240	99.8	2580	0	263400	5267	4158	66320	0.17	326.1	93	0.25	0.89	0.19	0
LCVA-05	10/18/12	0	0	0	80850	28760	27.8	2554	0	246600	5292	4060	63440	0	88.2	67.4	0.09	0.72	1.23	0
LCVA-06	10/18/12	0	0	0	82240	25720	6.9	2483	0	218700	5653	3887	58100	0	33.4	112.6	0	0.39	0	0
LCVA-07	10/18/12	0	0	0	98310	23030	0	2800	0	187400	4489	3709	52970	0	23.8	176.5	0	0.19	0	0
LCVA-08	10/18/12	0	0	0	53240	31890	44.9	2041	0	286100	7198	4330	68340	0.05	192.7	86.6	0.17	0.8	0	0
YC-01	10/18/12	0	0	0	51810	8531	12.5	1279	0	59780	5283	2922	22910	0	25	2	0	0.25	0	0
YC-02	10/18/12	0	0	0	52730	8378	11.5	1455	0	56810	5153	2829	22320	0.05	25	2.5	0	0.2	0	0
YC-03	10/18/12	0	0	0	55960	8070	13.9	1845	0	54270	3704	2709	20810	0	27.8	3	0	0.16	0	0
YC-04	10/18/12	0	0	0	66930	8637	21.9	1916	0	62010	3796	2849	21990	0	32.6	4.7	0	0.19	0	0
YC-05	10/18/12	0	0	0	74340	8503	29.4	2227	0	62300	3591	2789	21320	0.05	37.4	3.8	0	0.15	0	0
YC-06	10/18/12	0	0	0	122900	8922	51.6	2357	0	81660	4074	2924	23430	0.08	72.4	6.9	0.07	0.22	0	0
YC-07	10/18/12	0	0	0	125300	8863	39	2371	0	82540	4014	2893	23370	0.07	57.7	5.7	0	0.17	0	0
YC-08	10/18/12	0	0	0	32850	12870	46.8	2392	0	78680	1021	3426	29720	0.05	70.1	4.8	0.09	0.33	0	0
CC-01	10/19/12	0	0	0	61040	30930	8.1	2000	0	305400	3955	4952	65780	0	76.7	12.8	0.07	0.81	0	0
CC-02	10/19/12	0	0	0	61420	31040	8.5	2026	0	308900	3511	4977	66340	0	86.1	20.3	0.1	0.97	0	0
CC-03	10/19/12	0	0	0	67370	33140	7	1995	0	337900	3286	5191	70170	0	61.8	15	0.07	0.92	0	0
CC-04	10/19/12	0	0	0	74810	30950	6.8	2025	0	331100	3269	5262	68250	0	55.8	8.7	0.05	1.04	0	0
CC-05	10/19/12	0	0	0	82510	28850	4.2	2203	0	303000	5623	4625	61440	0	53.2	5.2	0	0.78	0	0
CC-06	10/19/12	0	0	0	83800	29310	4.5	2214	0	307600	5800	4688	62340	0	43.8	4.8	0	0.8	0	0
CC-07	10/19/12	0	0	0	85150	20710	5.8	2269	0	247600	7338	4183	50920	0	84	7.8	0.05	0.54	0	0
CC-08	10/19/12	0	0	0	88120	21280	6.1	2311	0	256900	6763	4272	51900	0	101.1	15	0.05	0.6	0	0
CC-09	10/19/12	0	0	0	235700	17630	4.5	2099	0	459600	9229	5270	40400	0	36.8	9.3	0.08	0.48	0	0
CC-10	10/19/12	0	0	0	69820	23250	5.5	2360	0	248100	5508	4213	55130	0	112.6	36	0.07	0.72	0	0
CC-11	10/19/12	0	0	0	301900	16130	2.7	2041	0	546300	10530	5783	34750	0	0	1.1	0.09	0.43	0	0
CC-12	10/19/12	0	0	0	81580	29690	3.9	2216	0	307900	5608	4681	62590	0	44.9	5.9	0	0.74	0	0
CC-13	10/19/12	0	0	0	58160	39390	7	1673	0	419500	1449	6553	86300	0	44.5	10.4	0.08	1.64	0	0
CC-14	10/19/12	0	0	0	60530	40610	9.9	1687	0	433400	1264	6738	88610	0	46.5	12.2	0.08	1.73	0	0
CC-15	10/19/12	0.96	0	0	62420	42780	122.8	1979	0	457900	922	7028	98730	0.21	369.8	40.4	0.34	2.77	0.36	0
RF-01	10/19/12	0	0	0	73210	47260	6.3	2260	0	446500	2231	5394	86610	0	134.1	31.8	0.12	1.05	0	0
RF-02	10/19/12	0	0	0	74260	47810	5.4	2262	0	455500	2266	5422	88370	0	164.4	56.8	0.16	1.22	0	0
RF-03	10/19/12	0	0	0	63280	51010	5.8	2137	0	463700	1910	5554	94830	0	139.9	52.1	0.17	1.35	0	0
RF-04	10/19/12	0	0	0	65550	51950	19.3	2099	0	493800	1810	5638	100600	0	210.5	65	0.23	1.52	0	0
RF-05	10/19/12	0	0	0	66650	52170	10.9	2053	0	494500	1507	5653	101400	0	142.7	77.4	0.23	1.55	0	0

RF-06	10/19/12	0	0	0	64490	56860	13.6	2002	0	553100	1012	5629	107800	0	180.1	108.3	0.3	1.24	0	0
RF-07	10/19/12	0	0	0	64580	56700	8.6	1970	0	556100	939	5627	107800	0	155.5	104.9	0.28	1.3	0	0
RF-08	10/19/12	0	0	0	56790	31710	7.5	2482	0	352900	2879	4436	78250	0	119.4	82	0.22	1.32	0	0
RF-09	10/19/12	0	0	0	106700	45780	20.3	2335	0	662000	2916	6633	113600	0	134.4	228.5	0.9	2.78	0	0
LCKY-01	11/15/12	2.19	0	4.41	49780	8172	14.2	1743	8.4	62620	4666	2438	21650	0.38	38.6	10.6	0	0.38	0	0
LCKY-02	11/15/12	2.35	0	4.11	15740	7651	14.6	1546	0	55300	3824	1979	19630	0.2	10.7	0.5	0	0.3	0	0
LCKY-03	11/15/12	1.99	0	4.08	15910	7965	14.3	1511	0	54480	4017	2041	20090	0.18	12.2	0.6	0	0.32	0	0
LCKY-04	11/15/12	2.04	0	4.5	15110	8278	16.1	1508	0	57440	4464	2104	20530	0.18	11.4	0.3	0	0.31	0	0
LCKY-05	11/15/12	1.7	0	4.4	14740	8267	16.2	1465	7.5	59020	4808	2109	20620	0.18	17.7	0.4	0	0.32	0	0
LCKY-06	11/15/12	2.65	0	2.86	17720	6372	14.1	1446	0	41230	10780	1583	14550	0.18	15.4	1.6	0	0.22	0	0
LCVA-01	11/15/12	1.99	0	3.82	73450	28370	7.5	2053	0	218200	6601	3800	60160	0.46	43.9	10	0.1	0.83	0	0
LCVA-02	11/15/12	1.94	0	3.71	71480	27500	9	2009	18	208900	6410	3724	59010	0.54	55.3	10	0.09	0.88	0.23	0
LCVA-03	11/15/12	2.71	0	3.94	75470	29170	9.6	2076	14.1	216800	6390	3909	62560	0.57	46.4	12.8	0.09	0.88	0.14	0
LCVA-04	11/15/12	2	0	4.18	76140	31410	9.4	2071	0	226500	6265	4051	65630	0.55	41.1	15.5	0.1	0.96	0.13	0
LCVA-05	11/15/12	2.5	0	3.45	78680	26430	6	2136	5	199400	6522	3780	59300	0.52	26.7	32.7	0.09	0.89	0	0
LCVA-06	11/15/12	0	0	3.29	80730	24590	3	2116	12.6	178600	6867	3686	55580	0.58	17.5	103.7	0.07	0.73	0	0
LCVA-07	11/15/12	1.9	0	2.98	109300	25440	0.4	2574	14.7	183900	4467	3941	59080	0.69	19.2	190.5	0.06	0.66	0	0
LCVA-08	11/15/12	2.27	0	4.72	43720	22170	9.9	1799	0	169500	9325	3299	48690	0.38	55.7	64.3	0.14	0.89	0.1	0
YC-01	11/15/12	0.47	0	3.75	28590	7304	16.2	1717	0	51670	3138	2004	18780	0.69	0	0.1	0	0.35	0	0
YC-02	11/15/12	0.6	0	3.99	29950	7607	20.3	1749	0	52220	3056	2048	19460	0.7	0	0.2	0	0.31	0	0
YC-03	11/15/12	0.45	0	4.05	31760	7363	20.7	1767	0	50400	2170	2004	18540	0.69	0	0.2	0	0.24	0	0
YC-04	11/15/12	0.44	0	3.77	40890	8290	25.8	1769	0	61230	2366	2222	20960	0.9	0	0.3	0	0.3	0	0
YC-05	11/15/12	0.49	0	3.79	48290	8165	29.8	1870	0	60840	2318	2263	20840	1.04	8.9	0.3	0	0.26	0	0
YC-06	11/15/12	0.42	0	4.17	79370	9446	36.2	1899	0	82150	2649	2514	25210	1.58	15.1	0.4	0	0.34	0	0
YC-07	11/15/12	0.66	0	4.52	83950	9623	44.1	1924	0	84560	2664	2534	25780	1.67	19.3	0.5	0.05	0.38	0	0
YC-08	11/15/12	0.31	0	3.6	24980	11230	16.1	1982	0	70510	973	2797	27340	0.83	0	0	0.05	0.38	0	0
CC-01	11/16/12	2.22	0	6.46	50270	32220	9.1	1488	0	267800	2388	4953	71290	0.44	44.9	9.2	0.13	1.52	0.21	0
CC-02	11/16/12	2.43	0	6.99	49870	31680	9.6	1504	7.3	270600	2189	4876	70260	0.39	44.2	10.2	0.13	1.47	0.21	0
CC-03	11/16/12	2.48	0	6.94	55620	34610	8.5	1506	0	285600	2065	5263	76410	0.44	32.8	9	0.13	1.71	0.29	0
CC-04	11/16/12	2.16	0	6.87	56420	32220	12.9	1524	0	285400	2019	5154	72650	0.41	28.2	4.8	0.1	1.66	0.26	0
CC-05	11/16/12	2.49	0	5.8	70960	26000	6.7	1632	0	242300	2982	4008	57040	0.45	40.3	6.8	0.1	1.14	0.19	0
CC-06	11/16/12	2.14	0	5.62	71850	26320	7.4	1610	0	237300	2929	4043	58130	0.43	106.9	6.9	0.1	1.12	0.23	0
CC-07	11/16/12	2.42	0	4.28	65800	20400	8.5	1565	0	196600	3075	3594	49650	0.4	55.5	10.1	0.1	0.93	0.16	0
CC-08	11/16/12	2.57	0	4.52	68240	21320	8.3	1645	5.3	188100	2860	3740	51370	0.45	60.3	16.6	0.11	1.02	0.24	0

CC-09	11/16/12	2.31	0	4.63	110900	20650	6.6	1723	24.9	253800	3953	4083	48990	0.54	48.8	15.2	0.12	0.87	0.2	0
CC-10	11/16/12	2.78	0	4.32	52430	20870	8.2	1719	4.9	180700	2622	3453	50140	0.49	73.2	35.1	0.13	0.88	0.31	0
CC-11	11/16/12	1.65	0	5.79	337000	18950	3.2	1905	0	562900	10490	6296	40770	0.99	0	0.3	0.13	0.78	0.13	0
CC-12	11/16/12	2.48	0	5.77	71620	27080	6.4	1604	4.1	226300	2775	4154	59310	0.43	39.5	4.6	0.09	1.04	0.19	0
CC-13	11/16/12	2.25	0	7.61	41500	39890	13.2	1418	0	339700	1141	6314	88290	0.4	18.7	5.7	0.14	2.22	0.2	0
CC-14	11/16/12	0.49	0	9.87	41250	39500	7.4	1535	0	362900	1815	6246	88140	1.14	0	2.3	0.1	1.91	0	0
CC-15	11/16/12	3.04	0	8.11	43870	41920	9	1548	0	347100	4954	6615	94930	0.37	14.2	12.9	0.16	2.72	0.23	0
RF-01	11/16/12	2.07	0	6.78	75330	50140	5.1	1811	4.4	429800	2627	5364	95550	0.47	80.7	55.9	0.24	1.74	0.17	0
RF-02	11/16/12	2.14	0	6.32	75490	49910	6.4	1827	8.7	438300	2585	5368	95880	0.47	99.1	75.8	0.27	1.89	0.17	0
RF-03	11/16/12	2.27	0	6.11	68860	53680	5.6	1747	9.9	432000	2255	5629	104200	0.48	76.3	76.6	0.29	2.05	0.17	0
RF-04	11/16/12	2.52	0	6.26	71250	54800	5.2	1725	0	470500	2223	5754	108900	0.43	64.1	71.8	0.3	2.18	0.45	0
RF-05	11/16/12	3.15	0	6.53	71240	53570	8.6	1736	3.8	484600	2507	5676	106800	0.42	63.3	84.3	0.32	2.23	0.29	0
RF-06	11/16/12	2.16	0	5.47	60950	60650	8.6	1647	0	481000	1456	5768	117400	0.47	66.9	100.2	0.36	2.1	0.25	0
RF-07	11/16/12	2.12	0	5.35	60190	59750	5.3	1673	4.8	501400	1564	5632	114500	0.49	55.2	94.8	0.36	1.98	0.18	0
RF-08	11/16/12	2.58	0	5.48	100400	39140	6.9	2001	10	473900	3457	5924	93940	0.44	53.1	86.3	0.37	2.04	0.23	0
RF-09	11/16/12	2.36	0	6.5	116200	47860	10.7	1979	6.6	581300	3313	6989	115200	0.43	49.8	176.4	0.73	2.73	0.21	0
LCKY-01	12/13/12	6.62	0	3.44	56880	7353	52.4	1872	22.4	58000	5308	2267	19560	0.78	144.7	39	0.11	0.39	0.38	0
LCKY-02	12/13/12	5.09	0	3.32	16630	6495	39.2	1639	0	45260	4543	1635	15920	0.38	27.3	1.4	0	0.25	0	0
LCKY-03	12/13/12	1.29	0	3.82	16300	6427	55.3	1682	0	47280	4747	1619	15710	0.46	17.9	0.5	0	0.21	0	0
LCKY-04	12/13/12	4.17	0	3.5	15650	6453	95.2	1627	0	45480	4988	1660	15350	0.38	57.4	2.1	0	0.27	0	0
LCKY-05	12/13/12	3.93	0	3.36	15200	6435	93.7	1607	0	46000	5256	1657	15310	0.36	47.5	1.6	0.05	0.25	0	0
LCKY-06	12/13/12	4.92	0	2.61	17950	2712	21.3	1477	0	22720	17500	788.8	6361	0.18	15.4	0.5	0	0.11	0	0
LCVA-01	12/13/12	4.06	0	4.02	55130	23380	27	2137	0	173900	7037	3325	49690	0.89	51.8	10.9	0.09	0.74	0.18	0
LCVA-02	12/13/12	0.44	0	4.02	55090	23370	31.3	2142	0	175300	7121	3303	49610	0.9	56	13.9	0.09	0.73	0.15	0
LCVA-03	12/13/12	3.99	0	4.13	56460	23800	24.7	2116	5	174800	6944	3399	50600	0.9	46.2	11.7	0.07	0.74	0.19	0
LCVA-04	12/13/12	4.35	0	4.13	57150	25400	33.6	2134	0	186800	6945	3514	52570	0.92	48.5	11.2	0.08	0.74	0.18	0
LCVA-05	12/13/12	4.25	0	3.79	59300	21920	32.4	2147	9.3	163800	7008	3351	48200	0.95	43.2	31.4	0.08	0.72	0.13	0
LCVA-06	12/13/12	6.58	0	3.58	60800	20380	44.6	2164	0	150400	7289	3268	45070	1.06	50.8	68.4	0.08	0.77	0.16	0
LCVA-07	12/13/12	4	0	2.65	106800	24730	0.6	2675	15.5	177700	4428	3958	56550	1.72	31.9	183.9	0.05	0.7	0	0
LCVA-08	12/13/12	4.09	0	4.36	34470	16730	76.4	1893	4.9	124700	8006	2822	36660	0.58	78	32.7	0.11	0.73	0.26	0
YC-01	12/13/12	4.38	0	3.41	23570	6575	99.3	2209	0	41040	2915	1851	15980	0.47	65.6	2.9	0.06	0.35	0.28	0
YC-02	12/13/12	4.31	0	3.47	24370	6647	92.8	2191	0	41190	2792	1857	16120	0.51	58.2	2.3	0.06	0.31	0.19	0
YC-03	12/13/12	4.29	0	3.3	25380	6528	113.2	2194	0	39850	2204	1802	15420	0.53	65.9	3.4	0.06	0.34	0.22	0
YC-04	12/13/12	4.45	0	3.7	34020	7130	114	2118	9.4	47100	2305	2004	17700	0.6	66.4	2.5	0.06	0.34	0.14	0

YC-05	12/13/12	4.09	0	3.24	42860	7171	108	2028	0	49230	2230	2013	17930	0.66	58.8	1.6	0.06	0.31	0.12	0
YC-06	12/13/12	4.24	0	3.46	77340	8823	146.1	1984	9.2	71370	2396	2430	23420	1.09	82.1	2.7	0.07	0.4	0.22	0
YC-07	12/13/12	3.73	0	3.59	77720	8868	156.6	2008	0	72150	2430	2403	23430	1.08	82.7	2.3	0.07	0.39	0.15	0
YC-08	12/13/12	4.09	0	3.63	23860	10440	63.9	2012	0	59280	991	2590	24500	0.6	33	1.2	0.08	0.37	0	0
CC-01	12/14/12	6.62	0	5.36	48550	26570	18.3	1943	0	231900	3165	4173	58140	0.78	63.2	15.4	0.11	1.17	0.34	0
CC-02	12/14/12	4.35	0	5.4	50230	27240	20.2	1940	0	238400	2884	4274	59190	0.76	58.3	15.7	0.12	1.28	0.29	0
CC-03	12/14/12	4.38	0	6.26	57310	29410	14.6	1855	4	264600	2760	4519	63410	0.75	47.4	14.7	0.12	1.34	0.35	0
CC-04	12/14/12	4.73	0	5.65	60740	27020	18.7	1859	0	255900	2696	4458	60510	0.79	50.9	11.4	0.1	1.37	0.27	0
CC-05	12/14/12	4.5	0	5.74	62920	23390	13.5	1996	18.2	219200	4372	3678	51280	0.78	64.2	10.9	0.1	1.09	0.21	0
CC-06	12/14/12	4.1	0	5.67	63880	23790	12.6	1961	0	220200	4044	3713	51650	0.79	45.8	9.7	0.1	1.05	0.26	0
CC-07	12/14/12	4.46	0	4.09	55680	14640	21.1	2008	0	158800	4864	2881	39200	0.67	76.1	23.6	0.11	0.78	0.2	0
CC-08	12/14/12	4.46	0	4.26	58530	15170	25.2	2054	4.2	168000	4904	2957	40530	0.69	92.5	38.8	0.14	0.83	0.18	0
CC-09	12/14/12	3.99	0	4.44	179700	16140	23.9	2054	8	301000	6859	4354	38920	1.36	67.4	26.5	0.15	0.82	0.21	0
CC-10	12/14/12	4.54	0	3.92	43030	15180	24.8	2093	3.4	147500	4202	2788	40450	0.7	111.5	58.9	0.16	0.91	0.13	0
CC-11	12/14/12	5.4	0	5.31	320500	17530	17.2	2137	3.4	489000	11080	6088	37110	2.23	12.2	0.9	0.14	0.74	0.25	0
CC-12	12/14/12	4.03	0	6.07	62480	24000	13.1	1975	0	222200	4129	3711	52010	0.87	45.8	9.3	0.09	1.03	0.27	0
CC-13	12/14/12	4.7	0	6.39	53100	34760	18.4	1668	0	321400	1329	5561	77560	0.76	34.4	11.4	0.12	1.88	0.25	0
CC-14	12/14/12	4.58	0	6.22	55150	35850	23	1653	0	329600	1239	5771	80240	0.81	38.2	13	0.12	1.94	0.33	0
CC-15	12/14/12	6.55	0	6.16	58770	38090	25.4	1641	0	353800	1020	6180	85640	0.88	44.7	20.1	0.15	2.34	0.33	0
RF-01	12/14/12	4.04	0	4.36	63620	41360	18.1	1963	0	346700	2123	4630	76680	0.86	77.2	69.1	0.23	1.48	0	0
RF-02	12/14/12	4.12	0	5.36	65570	42350	18.5	1988	0	348300	2053	4771	78320	0.88	100.8	85.3	0.27	1.55	0.16	0
RF-03	12/14/12	4.18	0	5.37	58020	43440	21.9	1919	7	352200	1885	4809	81420	1.14	124.1	87.9	0.28	1.72	0.2	0
RF-04	12/14/12	4.18	0	5.29	63940	45880	8.1	1909	8.2	412300	2163	5018	89100	0.93	85.8	84.6	0.31	1.74	0.22	0
RF-05	12/14/12	4.4	0	5.15	67220	46570	15.5	1897	0	427700	2126	5149	90870	0.92	117	96.8	0.33	1.93	0.22	0
RF-06	12/14/12	4.41	0	4.69	62500	52260	19	1768	0	464700	1440	5215	98690	0.95	102.5	108.6	0.33	1.74	0.2	0
RF-07	12/14/12	6.3	0	4.5	63080	52440	20	1787	0	472500	1288	5233	99140	0.94	121.2	109.5	0.35	1.84	0.21	0
RF-08	12/14/12	4.2	0	4.45	71100	26700	13.2	2073	0	305000	2540	4376	61560	0.71	86.9	68.9	0.25	1.32	0.19	0
RF-09	12/14/12	4.32	0	4.4	80530	33320	17	2002	0	402800	2795	5152	76410	0.78	93.4	129	0.46	1.78	0.19	0
LCKY-01	1/11/13	7.28	0	0	69550	9681	42.7	2362	21.3	82330	5551	2938	27360	0.1	146.4	31.2	0.09	0.43	0.51	0
LCKY-02	1/11/13	6.87	0	0	20220	8206	25.1	1861	0	64850	4435	2072	22600	0.07	39	6.3	0.07	0.35	0.38	0
LCKY-03	1/11/13	7.41	0	0	20100	7941	23.8	1839	0	64510	4805	2033	21690	0.06	36.3	3.8	0.06	0.28	0.17	0
LCKY-04	1/11/13	6.18	0	0	18460	7861	24.3	1786	0	64620	5583	2040	21090	0.06	42.6	12.7	0.07	0.29	0.2	0
LCKY-05	1/11/13	6.1	0	0	18180	7918	11.6	1696	0	65190	5833	2070	21130	0	12.7	1.2	0	0.26	0.13	0
LCKY-06	1/11/13	6.9	0	0	19320	5855	33.7	1638	0	45620	12430	1531	14840	0.08	60.6	7.8	0.08	0.29	0.28	0

LCVA-01	1/11/13	6	0	1.1	70650	26340	5.5	2604	0	208800	5734	3737	58650	0.05	40.3	12	0.06	0.59	0.19	0
LCVA-02	1/11/13	5.89	0	0.9	71220	26620	8.9	2631	0	210600	5742	3752	59380	0.06	51.1	18.1	0.07	0.58	0.14	0
LCVA-03	1/11/13	6.51	0	0.88	71770	26670	29.3	2652	0	212600	5698	3768	59870	0.07	126.6	42.8	0.12	0.69	0.33	0
LCVA-04	1/11/13	6.01	0	0	72020	28430	10.6	2634	0	224700	5628	3867	62610	0.05	52.6	32	0.08	0.67	0.1	0
LCVA-05	1/11/13	7.01	0	0	76650	24990	7.9	2735	0	200400	5808	3730	58460	0	35.6	69.5	0.07	0.63	0	0
LCVA-06	1/11/13	6.13	0	0	81930	22650	5.1	2751	0	180400	6345	3627	54010	0	32.3	118.5	0.05	0.48	0	0
LCVA-07	1/11/13	5.58	0	0	104200	22870	0.9	3147	0	176000	4533	3865	55460	0	27.3	178.2	0	0.41	0	0
LCVA-08	1/11/13	6.62	0	2.1	39680	22490	16.6	2220	0	190100	8686	3246	51170	0.05	90.2	56.6	0.11	0.68	0.25	0
YC-01	1/11/13	6.22	0	0.95	32730	9105	16.3	2325	0	70040	2654	2529	24850	0.06	19.4	2.4	0.05	0.34	0.32	0
YC-02	1/11/13	6.18	0	0.8	33830	9401	18.8	2300	0	70430	2423	2558	25630	0.05	24.4	5.5	0.05	0.31	0.32	0
YC-03	1/11/13	6.17	0	1.13	37780	9330	22.7	2337	0	70850	1596	2550	24970	0.08	28.8	2.8	0.05	0.33	0.34	0
YC-04	1/11/13	5.83	0	0	44600	10210	21.3	2280	0	79810	1640	2778	27950	0.08	24.7	2.5	0.06	0.36	0.16	0
YC-05	1/11/13	6.2	0	0	51660	10480	28.7	2286	0	82980	1614	2926	28870	0.09	39.2	5.2	0.07	0.38	0.24	0
YC-06	1/11/13	6.26	0	1.17	77560	11120	34.2	2220	0	105200	1651	3087	31790	0.12	43.4	3.4	0.07	0.41	0.42	0
YC-07	1/11/13	7.25	0	0	76810	11010	144.3	2304	0	103500	1651	3043	31400	0.22	242.6	24.3	0.28	0.71	0.64	0
YC-08	1/11/13	6.24	0	0	30970	13410	22.3	2424	0	87610	579	3493	35220	0.08	30.9	5.1	0.08	0.45	0.21	0
CC-01	1/12/13	6.88	0	3.53	45270	26920	9	1997	0	250000	2395	4213	63150	0	48.6	12.1	0.09	0.98	0.27	0
CC-02	1/12/13	6.65	0	4.11	46600	27530	7.1	2072	0	256700	2249	4294	63920	0.05	38.7	13.8	0.09	1.1	0.28	0
CC-03	1/12/13	6.56	0	3.48	51870	30000	7.1	2052	0	289400	2276	4574	69420	0.08	32.8	13	0.09	1.21	0.29	0
CC-04	1/12/13	6.47	0	3.1	55800	27690	7.9	2044	0	275600	2074	4554	66450	0.05	31.1	9.1	0.07	1.17	0.34	0
CC-05	1/12/13	6.24	0	3.38	63910	24860	8	2258	0	253000	3014	3882	57670	0	44.6	9.2	0.07	0.92	0.26	0
CC-06	1/12/13	6.44	0	3.37	64100	24970	8.5	2258	0	253700	2949	3893	57940	0.05	39.7	9.1	0.08	0.92	0.42	0
CC-07	1/12/13	6.68	0	1.46	55690	16060	11.9	2297	0	185000	3760	3113	44060	0.06	68.3	19	0.09	0.73	0.41	0
CC-08	1/12/13	7.07	0	1.35	54630	15700	9.5	2443	0	181500	3521	3084	43130	0.05	71.8	26.2	0.09	0.66	0.26	0
CC-09	1/12/13	6.31	0	1.3	45550	16980	10.1	2281	0	182900	3056	3061	46720	0.05	86.3	40.6	0.12	0.76	0.26	0
CC-10	1/12/13	6.46	0	1.06	41790	17090	9.1	2283	0	178400	2925	2988	46550	0	91.6	46	0.13	0.8	0.35	0
CC-11	1/12/13	5.71	0	2.93	303600	18470	4.9	2613	0	530300	10710	6109	41990	0.09	0	0.7	0.12	0.64	0	0
CC-12	1/12/13	9.91	0	3.23	50540	33770	221.7	2241	0	325600	1966	5436	93750	0.43	553.7	30	0.43	2.46	0.97	0
CC-13	1/12/13	6.31	0	3.69	62490	25250	8.5	2345	0	253200	3225	3930	57930	0.12	41.2	8	0.07	0.86	0.31	0
CC-14	1/12/13	6.3	0	3.05	51630	33720	11.4	1970	0	331200	1489	5482	81010	0.05	17.7	7.9	0.09	1.71	0.26	0
CC-15	1/12/13	7.08	0	3.23	54350	35190	10.3	1977	0	352500	957	5678	85200	0.06	27	14.6	0.1	1.99	0.27	0
RF-01	1/12/13	6.3	0	3.96	69680	45580	5.3	2330	0	423600	2175	5209	89630	0.05	94.6	60.8	0.18	1.32	0.28	0
RF-02	1/12/13	6.49	0	3.52	70120	45740	4.8	2366	0	423700	1979	5220	89860	0.05	113.9	68.8	0.19	1.46	0.37	0
RF-03	1/12/13	6.32	0	3.46	61320	46950	5.1	2219	0	424600	1601	5214	93920	0	98	69.5	0.19	1.52	0.38	0

RF-04	1/12/13	6.26	0	3.53	63850	46600	6.4	2136	0	438000	1525	5277	96700	0	79.6	55.3	0.19	1.52	0.23	0
RF-05	1/12/13	6.64	0	3.78	66780	47250	5.8	2173	0	451500	1470	5400	99240	0	78.9	72.2	0.22	1.65	0.11	0
RF-06	1/12/13	6.34	0	2.69	58640	51220	10.4	2054	0	474000	1235	5261	104800	0	95.8	88.8	0.25	1.44	0.2	0
RF-07	1/12/13	6.31	0	2.39	54550	54470	6.9	1946	0	496900	870	5310	111300	0	94	84.4	0.23	1.34	0.19	0
RF-08	1/12/13	6.19	0	2.76	74530	31410	7.8	2341	0	380700	1726	4967	77950	0	72.4	51.1	0.18	1.17	0.17	0
RF-09	1/12/13	6.21	0	2.87	86270	38340	10.3	2288	0	479200	1723	5734	94710	0	88.7	117.3	0.34	1.51	0.17	0
LCKY-01	2/14/13	8.6	0	1.05	78970	9962	23.7	2422	0	83740	6300	3100	27240	0.76	81	34.2	0.08	0.42	0.5	0
LCKY-02	2/14/13	8.44	0	0	18110	7648	24.1	1933	0	56750	6071	1969	20570	0.32	23.5	4.7	0	0.27	0.28	0
LCKY-03	2/14/13	7.97	0	0	17560	7285	21.9	1877	0	54960	6227	1911	19360	0.29	19.2	1.3	0	0.26	0.13	0
LCKY-04	2/14/13	7.61	0	0	16290	7276	23.2	1860	0	55130	7235	1920	18970	0.25	25.6	2.4	0	0.28	0.19	0
LCKY-05	2/14/13	7.79	0	0	15960	7219	23.1	1795	0	55880	7711	1904	18900	0.24	23.2	2.3	0.05	0.28	0.19	0
LCKY-06	2/14/13	202.3	0	0	17280	5109	176.2	1642	0	36800	14960	1345	12740	0.19	277.9	63.6	0.72	1	2.07	0
LCVA-01	2/14/13	8	0	1.68	72860	30060	11.2	2624	0	237200	6537	4090	64530	0.76	59.4	38.9	0.08	0.71	0.23	0
LCVA-02	2/14/13	7.58	0	1.36	72790	29940	6.7	2663	0	236900	6513	4095	64250	0.79	32	29	0.06	0.67	0.18	0
LCVA-03	2/14/13	8.19	0	1.7	73200	30030	13.7	2656	0	233600	6326	4148	64690	0.76	61	50.9	0.09	0.79	0.24	0
LCVA-04	2/14/13	8.49	0	1.44	75640	29970	10.8	2687	0	234700	6356	4208	65400	0.79	47.5	55.6	0.09	0.78	0.25	0
LCVA-05	2/14/13	7.89	0	0	77840	26160	9.7	2760	0	213300	6457	3948	60350	0.82	40.6	88.4	0.08	0.75	0.25	0
LCVA-06	2/14/13	7.74	0	0	75940	21770	8.5	2730	0	177700	7750	3568	51560	0.82	34.5	100.3	0.06	0.51	0.17	0
LCVA-07	2/14/13	7.48	0	0	110100	22890	1.2	3186	8	187600	3710	4069	55590	1.25	42.7	182	0	0.48	0	0
LCVA-08	2/14/13	8.32	0	2.01	36230	20730	27.5	2233	0	161700	10880	3143	46310	0.42	85.1	48	0.14	0.71	0.4	0
YC-01	2/14/13	8.01	0	0	31740	8142	79.1	2399	0	61600	2818	2442	21450	0.54	54.4	3.5	0.08	0.42	0.43	0
YC-02	2/14/13	9.26	0	0	33270	8489	95.8	2394	0	61790	2777	2522	22510	0.48	87	11.3	0.14	0.43	0.65	0
YC-03	2/14/13	8.02	0	0	36310	8575	102.8	2453	0	63350	1989	2472	22590	0.51	67.4	4.8	0.09	0.36	0.33	0
YC-04	2/14/13	8.43	0	1.12	45040	9825	102.7	2462	0	74000	2144	2829	26250	0.59	72.5	6.1	0.1	0.46	0.71	0
YC-05	2/14/13	8.24	0	0	53400	10130	91.7	2432	0	76810	2202	3033	27670	0.61	72.5	9	0.13	0.47	0.4	0
YC-06	2/14/13	7.84	0	0	75820	11080	130.9	2411	0	99800	1358	3205	31400	0.79	76.7	4.5	0.09	0.44	0.38	0
YC-07	2/14/13	8.76	0	0	75230	11020	178.6	2424	0	100400	1352	3149	31150	13.63	238.1	18.3	0.22	0.82	1.18	0
YC-08	2/14/13	9.24	0	0	28730	14190	74.9	2450	0	94650	474	3553	37090	0.52	87.5	10.8	0.25	0.72	0.48	0
CC-01	2/15/13	8.47	0	4.29	45610	29110	22	2447	0	255900	2851	4669	67000	0.51	39.1	15	0.1	1.24	0.48	0
CC-02	2/15/13	8.92	0	4.62	45990	29370	28.6	2438	0	263800	2532	4690	67330	0.53	65.5	20.4	0.12	1.35	0.62	0
CC-03	2/15/13	9.11	0	5.65	52880	32690	28.1	2415	0	296400	2366	5136	74020	0.54	61	20.9	0.13	1.81	0.7	0
CC-04	2/15/13	8.98	0	4.77	56630	30170	29	2383	0	291600	2391	5010	70640	0.54	61.9	19.5	0.14	1.64	0.49	0
CC-05	2/15/13	10.77	0	5	68630	28330	123.4	2585	0	283100	3756	4462	65590	0.62	226.7	53.5	0.35	1.58	0.99	0
CC-06	2/15/13	8.89	0	5.27	69600	28590	48.8	2533	0	284800	3611	4526	64670	0.61	68.8	23.5	0.15	1.25	0.42	0

CC-07	2/15/13	9.05	0	1.88	59400	17790	71.2	2585	0	199200	4630	3475	47220	0.52	116	38.2	0.22	0.99	0.48	0
CC-08	2/15/13	9.81	0	2.08	52120	16640	80.7	2712	0	182400	4222	3224	43570	0.48	133.1	39.3	0.21	1.02	0.51	0
CC-09	2/15/13	8.39	0	2.56	131400	19460	48.7	2533	0	307100	4907	4415	49950	0.72	85	35.3	0.2	1.05	0.33	0
CC-10	2/15/13	9.7	0	1.9	38310	18550	88.4	2622	0	179200	4392	3189	48750	0.49	191.5	63.3	0.29	1.12	0.49	0
CC-11	2/15/13	7.4	0	5.05	331900	22550	15.4	2734	0	642500	7549	6941	53070	2.84	26.6	3.7	0.13	0.8	0.31	0
CC-12	2/15/13	8.7	0	5.79	66050	28940	50.9	2569	0	286900	3617	4509	65490	0.65	90	24.9	0.17	1.24	0.41	0
CC-13	2/15/13	8.95	0	4.84	48010	35960	25	2259	0	342100	1205	5991	84910	0.52	57.1	18.6	0.15	2.3	0.48	0
CC-14	2/15/13	10.1	0	4.74	49230	36680	27	2249	0	351000	1046	6081	86590	0.57	61.9	17.7	0.16	2.27	0.48	0
CC-15	2/15/13	10.18	0	5.07	51420	38370	36.8	2232	0	377000	666	6287	91060	0.6	81.2	20.8	0.19	2.7	0.42	0
RF-01	2/15/13	9.25	0	4.48	64670	47560	44.6	2399	0	408500	1873	5482	93710	0.64	227.5	80	0.39	2.02	0.51	0
RF-02	2/15/13	9.32	0	4.77	66500	48790	44.7	2467	0	423500	1584	5626	95670	0.7	267.8	87.7	0.41	2.06	0.5	0
RF-03	2/15/13	9.42	0	4.96	60250	49700	45	2348	0	428200	1479	5623	99110	0.69	195.9	76.8	0.41	2.28	0.45	0
RF-04	2/15/13	8.08	0	5.09	63850	48880	20.2	2300	0	435600	1467	5700	101500	0.66	27.8	49.8	0.29	2.06	0.24	0
RF-05	2/15/13	10.02	0	5.33	65260	49050	55.1	2341	0	442300	1464	5698	102000	0.69	251.5	90.7	0.51	2.57	0.46	0
RF-06	2/15/13	10.39	0	4.64	64320	45190	59.4	2358	0	415100	1319	5340	94190	0.68	238.2	84.9	0.49	2.54	0.47	0
RF-07	2/15/13	9.31	0	3.43	55170	58440	59.6	2167	0	490900	750	5922	118900	0.66	212.7	93.8	0.49	2.16	0.46	0
RF-08	2/15/13	9.61	0	2.96	67400	31820	72.2	2552	0	347900	2830	5026	77580	0.57	253.5	89.2	0.71	2.07	0.43	0
RF-09	2/15/13	393.3	0	2.4	76420	38180	616.3	2520	13.9	446300	3072	5407	89340	0.7	2065	240	1.87	3.11	3.03	0
LCKY-01	3/21/13	7.93	0	0	54390	8473	6.8	2145	0	64590	5526	2390	22120	0.07	35.1	19.7	0	0.33	0.18	0
LCKY-02	3/21/13	8.25	0	0	14410	6296	8.6	1816	0	42880	6017	1555	16470	0.07	0	3	0	0.24	0	0
LCKY-03	3/21/13	7.11	0	0	14320	6092	8.2	1801	0	41980	6438	1518	15420	0.08	0	5.5	0	0.21	0	0
LCKY-04	3/21/13	8.03	0	0	13960	6179	21.2	1792	0	43840	7696	1559	15570	0.1	24.3	5.4	0.05	0.29	0.27	0
LCKY-05	3/21/13	7.35	0	0	13850	6101	7.9	1708	0	43550	8179	1564	15370	0	0	1.4	0	0.22	0	0
LCKY-06	3/21/13	7.54	0	0	17860	4955	7.4	1593	0	31090	18270	1203	11140	0	0	0.7	0	0.19	0.11	0
YC-01	3/21/13	8.13	0	0	20590	6630	28.1	2343	0	46360	2537	1785	17140	0.27	33.7	4.6	0.07	0.36	0.22	0
YC-02	3/21/13	7.73	0	0	21750	6888	22.3	2308	0	46470	2399	1820	17720	0.05	23.8	2.1	0.05	0.28	0.21	0
YC-03	3/21/13	7.38	0	0	23500	6890	24.4	2264	0	47510	1748	1787	17660	0.1	26.1	2.3	0.06	0.28	0.16	0
YC-04	3/21/13	7.35	0	0	30570	8112	15.5	2245	0	57940	1879	2073	21360	0.1	14.4	4.7	0.05	0.33	0.12	0
YC-05	3/21/13	7.4	0	0	37480	8408	16.9	2144	0	61310	1752	2202	22470	0.1	15.7	2.9	0.06	0.29	0.18	0
YC-06	3/21/13	7.27	0	0	58640	9526	26	1980	0	80640	1385	2469	25260	0.17	24.8	10.7	0.09	0.39	0.15	0
YC-07	3/21/13	7.12	0	0	60520	9677	22.9	2044	0	81390	1406	2503	25860	0.13	20.8	2.4	0.06	0.32	0.13	0
YC-08	3/21/13	7.27	0	0	20770	11170	6.3	2253	0	69980	688	2703	28270	0.42	0	0.3	0.06	0.38	0.11	0
CC-01	3/22/13	8.37	0	1.56	34150	25210	12.4	2264	0	210300	2764	3826	55870	0.05	24.8	12.5	0.1	1.2	0.3	0
CC-02	3/22/13	7.99	0	1.75	34940	25270	6.3	2292	0	212800	2569	3836	55320	0.09	14.4	12.5	0.1	1.16	0.28	0

CC-03	3/22/13	8.13	0	1.65	39200	27920	9.5	2177	0	239700	2315	4160	60430	0.1	16.3	11.3	0.11	1.35	0.33	0
CC-04	3/22/13	7.96	0	1.89	41590	26620	7.8	2148	0	233800	2143	4185	59180	0.14	14.1	9.4	0.1	1.32	0.28	0
CC-05	3/22/13	7.91	0	1.19	48840	20390	9.4	2424	0	186900	4033	3262	45720	0	39.7	21.6	0.14	0.89	0.3	0
CC-06	3/22/13	7.53	0	0.95	48510	20790	16.3	2286	0	193900	2768	3265	46430	0.07	17.7	18.6	0.13	0.89	0.22	0
CC-07	3/22/13	7.75	0	0	42520	14690	19.7	2343	0	148100	2874	2581	36890	0.1	26.4	30.6	0.15	0.85	0.19	0
CC-08	3/22/13	7.98	0	0	43960	15000	18.4	2324	0	154400	2644	2628	38870	0.09	28.3	30.2	0.15	0.83	0.25	0
CC-09	3/22/13	7.8	0	1.49	143300	17680	11.3	2293	0	301500	3828	4037	42710	0.07	13.1	13.1	0.15	0.79	0.3	0
CC-10	3/22/13	8.07	0	0	33100	15280	23.6	2365	0	138500	2392	2466	39320	0.06	35.8	45	0.18	0.89	0.23	0
CC-11	3/22/13	6.87	0	3.44	292600	21830	9.5	2382	0	574200	5925	6089	51980	0.1	0	1.3	0.13	0.75	0.38	0
CC-12	3/22/13	8.95	0	1.68	48710	21740	96.4	2436	0	194100	2769	3365	46930	0.13	95.9	30	0.23	0.94	0.41	0
CC-13	3/22/13	8.28	0	2.11	35510	33320	4	1981	0	284200	1342	5096	73680	0.07	0	7.2	0.09	1.94	0.35	0
CC-14	3/22/13	8.8	0	2.11	37310	34300	5	1984	0	287900	1286	5326	75770	0.1	0	7.9	0.1	2.14	0.37	0
CC-15	3/22/13	9.53	0	2.31	39730	36790	6	1970	0	312400	981	5628	81300	0.11	0	9.6	0.11	2.36	0.4	0
LCVA-01	3/22/13	8.29	0	0	60360	27820	21.1	2475	0	206600	8186	3514	57860	0.07	77.3	49.7	0.12	0.74	0.27	0
LCVA-02	3/22/13	8.19	0	0	62000	27850	18.4	2486	0	207300	8269	3540	57340	0.07	70.3	56.9	0.11	0.81	0.29	0
LCVA-03	3/22/13	7.94	0	0	60830	27200	7.2	2526	0	205700	8245	3482	57050	0	26.9	35	0.08	0.74	0.27	0
LCVA-04	3/22/13	8.55	0	0	65800	27470	22.6	2587	0	204800	8495	3579	57440	0.14	77	64.2	0.12	0.77	0.28	0
LCVA-05	3/22/13	8.02	0	0	65490	24740	9.5	2599	0	190500	8173	3441	54410	0.07	42.2	73.6	0.08	0.74	0.2	0
LCVA-06	3/22/13	7.72	0	0	71350	21820	1.6	2625	0	172100	9064	3278	49150	0.15	16.3	99.4	0.06	0.56	0.13	0
LCVA-07	3/22/13	7.64	0	0	108300	25190	0	3116	0	203700	3745	3993	57850	0.15	27.3	189.3	0.07	0.52	0.18	0
LCVA-08	3/22/13	7.89	0	0	33640	18960	4.4	2214	0	143000	13260	2685	41290	0.3	17.1	22.3	0.07	0.69	0.18	0
RF-01	3/22/13	8.35	0.24	2.72	55590	43940	22.4	2330	0	359400	1958	4723	79930	0.12	88.6	49.5	0.28	1.66	0.46	0
RF-02	3/22/13	10.04	0	1.93	55150	43410	81.2	2387	0	356200	1829	4645	80160	0.13	366	86.6	0.44	1.87	0.59	0
RF-03	3/22/13	8.84	0	2.16	49690	45150	31.3	2252	0	362300	1636	4740	83080	0.14	121.8	56.4	0.32	1.71	0.46	0
RF-04	3/22/13	9.14	0	2.2	53560	47300	16.2	2240	0	382700	1674	4963	88500	0.07	51	46.2	0.28	1.82	0.49	0
RF-05	3/22/13	8.41	0	2.53	53980	45860	22.4	2216	0	379500	1543	4941	88850	0	39.5	47.3	0.28	1.89	0.43	0
RF-06	3/22/13	9.54	0	1.85	61560	31000	12.2	2486	0	273500	1898	4313	63280	0.19	24.2	38.6	0.26	1.91	0.54	0
RF-07	3/22/13	8.46	0	1.78	46920	57340	27	2048	0	459400	1097	5324	108200	0.06	90.2	61.7	0.34	1.86	0.56	0
RF-08	3/22/13	8.39	0	1.11	51580	27950	25.6	2466	0	266500	1915	4037	62770	0.06	34.2	52.8	0.38	1.38	0.38	0
RF-09	3/22/13	8.29	0	1.17	58470	34360	27.9	2340	0	334800	1651	4653	76750	0.16	26.7	73.1	0.51	1.72	0.44	0
CC-01	4/24/13	15.75	0	1.51	40720	27150	24.3	2298	0	218600	2341	4177	57630	0.22	47.9	13.4	0.12	1.16	11.49	0
CC-02	4/24/13	7.98	0	1.14	40380	27450	21.2	2276	0	223800	2177	4179	58170	0.16	36.5	11.6	0.12	1.22	0.43	0
CC-03	4/24/13	7.79	0	2.1	45580	29840	15.8	2228	0	247900	2043	4470	62230	0.25	18	8.6	0.1	1.31	0.36	0
CC-04	4/24/13	7.62	0	1.67	50190	27970	28.4	2226	0	244200	2039	4506	60650	0.2	44.6	10.5	0.12	1.37	0.43	0

CC-05	4/24/13	8.06	0	1.29	58590	23180	34.5	2631	0	209700	5180	3790	51120	0.4	68	16.3	0.14	1.05	0.44	0
CC-06	4/24/13	7.7	0	1.75	60680	24790	36.9	2432	0	223300	2663	3870	52680	0.25	42	11.2	0.12	1.05	0.52	0
CC-07	4/24/13	8.05	0	0	52950	17050	57.4	2439	0	172300	2700	3112	41740	0.23	89.7	15.9	0.17	0.86	0.58	0
CC-08	4/24/13	34.26	0	0	35410	14630	1238	3153	28.7	124900	2068	2552	42320	0.98	2126	301.7	5.39	6.44	5.03	0
CC-09	4/24/13	9.93	0	0.97	153700	20570	186.1	2464	0	338700	3400	4369	49930	0.59	344.2	82.7	0.78	1.66	0.85	0
CC-10	4/24/13	10.01	0	0	36770	18770	187.2	2574	0	159500	2219	2998	45230	0.41	364.7	133.3	0.89	1.76	0.83	0
CC-11	4/24/13	6.98	0	3.83	307700	25610	15.8	2334	0	633300	5271	6519	58460	0.44	8	3.3	0.13	0.91	0.37	0
CC-12	4/24/13	7.45	0	1.71	56990	23950	35.3	2465	0	216600	2537	3805	51760	0.55	40.4	10.3	0.12	1.03	0.41	0
CC-13	4/24/13	7.71	0	1.92	40980	32920	10.8	2070	0	282500	1145	5241	73330	0.21	13.4	6.5	0.11	1.98	0.42	0
CC-14	4/24/13	8.4	0	1.61	42650	34540	18.1	2093	0	287000	1118	5428	74900	0.24	34.2	10.5	0.14	2.16	0.55	0
CC-15	4/24/13	1.48	0	1.54	44150	34870	14.7	2079	0	302100	871	5598	78040	0.23	21.6	10.4	0.12	2.42	0.55	0
LCVA-01	4/24/13	0.58	0	0	66960	29540	26.1	2798	0	224300	5767	3861	60400	0.54	89.1	40.3	0.14	0.84	0.4	0
LCVA-02	4/24/13	0	0	0	68020	29630	10.1	2812	0	223800	5755	3886	60170	0.36	25.9	11.2	0.07	0.7	0.27	0
LCVA-03	4/24/13	0.92	0	0	68960	29580	45.9	2873	0	227900	5757	3888	61310	0.29	144.6	62.9	0.17	0.94	0.48	0
LCVA-04	4/24/13	0.83	0	0	69830	30850	35.6	2844	0	236800	5735	3971	63010	0.34	122.3	69.4	0.15	0.95	0.41	0
LCVA-05	4/24/13	0.26	0	0	74850	26680	23	2852	0	208200	5824	3751	57360	0.37	80.1	87.8	0.1	0.86	0.28	0
LCVA-06	4/24/13	0	0	0	80400	23640	9.6	2808	0	193000	6762	3547	52590	0.47	43.8	116	0.08	0.63	0.22	0
LCVA-07	4/24/13	0	0	0	109500	26270	0	3177	0	221100	3740	4020	59970	0.4	45.5	187.6	0.07	0.57	0.13	0
LCVA-08	4/24/13	0.61	0	0	33530	19690	31.9	2320	0	146800	9380	2936	40690	0.18	92.6	37.3	0.16	0.73	0.43	0
RF-01	4/24/13	8.64	0	1.46	57130	45390	28.7	2177	0	355500	1663	5019	82110	0.34	135.1	43.3	0.24	1.6	1.55	0
RF-02	4/24/13	7.54	0	2.32	59160	46740	13.9	2252	0	357600	1651	5132	82990	0.36	63.9	36.4	0.21	1.68	0.42	0
RF-03	4/24/13	7.5	0	2.4	52990	47050	25.9	2182	0	361600	1481	5146	86770	0.21	101.5	42.4	0.26	1.77	0.48	0
RF-04	4/24/13	8.12	0	2.25	55710	47850	28.3	2188	0	375200	1463	5262	89550	0.21	94.8	40.3	0.28	1.94	0.53	0
RF-05	4/24/13	8.75	0	2.74	56470	47770	24.4	2190	0	383400	1406	5295	91200	0.22	89.6	41.7	0.28	1.97	0.51	0
RF-06	4/24/13	9.12	0	2.22	63580	31420	18.2	2470	0	264800	1578	4499	63040	0.44	38.7	27.2	0.23	2.16	0.4	0
RF-07	4/24/13	8.16	0	1.62	46040	61970	30.9	2030	0	494400	646	5659	112200	0.23	129.4	58.7	0.32	1.86	0.58	0
RF-08	4/24/13	8.28	0	1.52	55830	30390	31.8	2447	0	287100	1934	4429	67280	0.23	36.1	41.1	0.37	1.57	1.09	0
RF-09	4/24/13	8.34	0	2.03	65960	39420	49.8	2339	0	383700	1706	5264	86340	0.24	55.8	72.2	0.66	2.22	0.53	0
LCKY-01	4/25/13	7.85	0	0	73530	9640	25	2330	0	75250	5853	2837	25060	0.51	101	29	0.08	0.44	0.41	0
LCKY-02	4/25/13	7.21	0	0	17880	8036	31.1	1885	0	51330	6256	2005	21380	0.72	42.4	4.7	0.08	0.35	0.22	0
LCKY-03	4/25/13	7.26	0	0	17690	7605	34.7	1851	0	49800	6666	1940	20180	0.22	67	5.4	0.08	0.63	0.19	0
LCKY-04	4/25/13	7.33	0	0	16860	7700	36.4	1815	0	50890	7783	2001	20130	0.09	46.6	5.1	0.08	0.35	0.17	0
LCKY-05	4/25/13	6.66	0	0	16900	7839	33.2	1737	0	51720	8316	2058	20570	0.09	40.7	4.4	0.07	0.37	0.14	0
LCKY-06	4/25/13	7.88	0	0	20760	5961	35.5	1633	0	36570	18930	1507	14620	0.26	48.8	5.1	0.08	0.27	0.15	0

YC-01	4/25/13	9.71	0	0	29570	8986	35.4	2540	0	62100	2680	2469	23660	0.14	23.9	2.3	0.08	0.44	0.28	0
YC-02	4/25/13	6.99	0	0	30000	9325	35.1	2438	0	61920	2437	2513	24020	0.14	24.6	2.7	0.07	0.39	0.29	0
YC-03	4/25/13	7.96	0	0	32920	9327	43.5	2420	0	62320	1730	2480	24170	0.12	43.3	4.5	0.09	0.36	0.82	0
YC-04	4/25/13	6.79	0	0	39570	10380	34.3	2405	0	71570	1781	2732	26480	0.18	23.7	2.3	0.08	0.38	0.26	0
YC-05	4/25/13	7.05	0	0	44810	10660	70.3	2398	0	76090	1688	2864	27700	0.33	86.9	8.9	0.17	0.53	0.33	0
YC-06	4/25/13	7.02	0	0	66420	11010	71.1	2274	0	91050	1329	3009	30080	0.36	82.2	9.5	0.15	0.56	0.36	0
YC-07	4/25/13	7.5	0	0	65980	11030	70.3	2254	0	89690	1283	2995	29810	0.25	83.5	10.6	0.15	0.53	0.3	0
YC-08	4/25/13	7.87	0	0	24430	13840	89	2508	0	84450	650	3287	34590	0.28	122.9	10.5	0.27	0.73	0.45	0
YC-SOURCE	4/25/13	7.3	0	0	66890	11170	76.6	2237	0	92030	1195	3072	30600	0.3	93.7	10.7	0.16	0.55	0.33	0
CC-01	5/29/13	5.87	0	0	48210	26570	6	2184	0	257800	2621	4397	62910	0	34.2	8.4	0.06	0.64	0	0
CC-02	5/29/13	5.03	0	0	48050	26880	6.1	2258	0	260600	2268	4417	62910	0	27	9	0.05	0.66	0	0
CC-03	5/29/13	5.43	0	0	51460	28300	13	2207	0	277900	2200	4597	65880	0	43.9	11.2	0.08	0.88	0	0
CC-04	5/29/13	5.44	0	0	55470	26700	6.5	2239	0	272600	2078	4678	64640	0	23.1	4.9	0.05	0.96	0	0
CC-05	5/29/13	5.11	0	0	65440	23930	7.4	2317	0	249800	2836	3972	56210	0	31.5	4	0.05	0.52	0	0
CC-06	5/29/13	5.6	0	0	65480	23960	13.7	2293	0	250400	2788	3961	56020	0	44.3	6.6	0.05	0.61	0	0
CC-07	5/29/13	5.17	0	0	66110	14720	9.4	2341	0	188700	3398	3160	41820	0	46.6	6.3	0.05	0.34	0	0
CC-08	5/29/13	5.35	0	0	66980	15020	9.8	2372	0	192500	3349	3196	42240	0	54.7	11.8	0.06	0.36	0	0
CC-09	5/29/13	5.25	0	0	87700	15100	10.3	2343	0	219200	3464	3378	41730	0	54.8	16	0.07	0.29	0	0
CC-10	5/29/13	5.28	0	0	38510	15230	10.7	2438	0	159600	2580	2839	43410	0	70.9	26.3	0.06	0.34	0	0
CC-11	5/29/13	4.28	0	0	290900	15470	5.5	2006	0	487400	7101	5433	34280	0	0	1.2	0.1	0.31	0	0
CC-12	5/29/13	5.06	0	0	63620	24670	6.4	2332	0	253200	2720	3983	57040	0	22.9	3.7	0.05	0.51	0	0
CC-13	5/29/13	5.04	0	0	45400	30740	7.8	2096	0	302000	1103	5331	73540	0	13.7	5.1	0.06	1.23	0	0
CC-14	5/29/13	5.61	0	0	45740	31080	7.2	2093	0	305400	1044	5389	74450	0	15.5	6.1	0.06	1.54	0	0
CC-15	5/29/13	6.22	0	0	47600	31710	8.4	2072	0	315500	897	5555	76650	0	18	10.3	0.07	1.82	0	0
LCVA-01	5/29/13	4.8	0	0	68900	31460	4.1	2375	0	276500	5013	3907	69370	0	22.8	5.7	0	0.34	0	0
LCVA-02	5/29/13	5.22	0	0	68880	31340	4.1	2375	0	275800	5143	3913	69390	0	26.3	5.4	0	0.41	0	0
LCVA-03	5/29/13	4.64	0	0	68680	31170	2.9	2336	0	274800	5004	3896	68700	0	16.5	5.1	0	0.43	0	0
LCVA-04	5/29/13	19.55	0	0	69450	30820	11	2386	0	275200	5137	3908	69310	0	41.8	14.6	0.05	1.31	0	0
LCVA-05	5/29/13	4.89	0	0	73630	26260	2.1	2579	0	241600	5005	3693	63200	0	15.4	37.9	0	0.38	0	0
LCVA-06	5/29/13	22.86	0	0	91270	22740	0	2772	0	216600	3458	3632	56700	0	47.4	181.3	0	0.16	0	0
LCVA-07	5/29/13	4.62	0	0	92400	23180	0	2838	4.1	220400	3352	3682	57640	0	146.8	184.3	0	0.12	0	0
LCVA-08	5/29/13	5.32	0	0	42430	21980	30.4	2158	0	195200	9910	3267	50960	0	132.8	27.5	0.11	0.37	0	0
RF-01	5/29/13	5.26	0	2.39	70930	45180	8.4	2257	0	422900	2343	5184	86340	0	72.9	25.3	0.14	0.92	0.39	0

RF-02	5/29/13	5.95	0	1.01	70580	45180	8.8	2283	0	422100	2181	5206	88720	0	91.6	36.6	0.15	0.96	0.33	0
RF-03	5/29/13	5.29	0	0	64440	47120	9	2215	0	438600	1926	5375	94290	0	87.1	32	0.16	1.16	0.27	0
RF-04	5/29/13	5.05	0	0	66950	46600	8.8	2212	0	450400	1860	5443	96480	0	78	29.5	0.15	1.28	0.2	0
RF-05	5/29/13	5.22	0	0	67820	46260	9.4	2215	0	447800	1725	5447	97290	0	83.7	35.4	0.18	1.3	0	0
RF-06	5/29/13	6.02	0	0	73110	34570	9.9	2473	0	358100	2053	4926	76660	0	47.1	20.2	0.11	1.65	0.16	0
RF-07	5/29/13	5	0	0	60240	52760	9.8	2011	0	503000	1010	5361	105100	0	131	47.8	0.19	1.02	0	0
RF-08	5/29/13	4.83	0	0	72200	30740	21.4	2485	0	365100	2367	4894	76000	0	48.6	32	0.18	0.95	0	0
RF-09	5/29/13	4.98	0	0	80330	36300	29.7	2360	0	444200	2130	5494	90000	0	42.4	55.7	0.34	1.32	0	0
LCKY-01	5/30/13	5.98	0	0	100600	8757	12.5	2416	9.7	87930	6618	3166	25730	0	127.1	43.1	0	0.1	0	0
LCKY-02	5/30/13	5.21	0	0	18190	8011	13.2	1941	0	57670	5590	2160	22680	0	13.8	1.7	0	0	0	0
LCKY-03	5/30/13	4.77	0	0	17590	7692	14	1956	0	56380	5650	2117	21300	0	16.2	4.5	0	0	0	0
LCKY-04	5/30/13	5.16	0	0	16250	7934	48.6	2011	0	57840	6463	2206	21550	0	88.2	6	0.07	0.13	0	0
LCKY-05	5/30/13	4.85	0	0	15900	8049	19.5	1918	0	58360	6819	2252	22040	0	26.8	3.3	0	0	0	0
LCKY-06	5/30/13	4.85	0	0	19110	6080	15.6	1817	0	39520	17110	1627	15190	0	24.1	1.8	0	0	0	0
YC-01	5/30/13	4.96	0	0	47310	8643	14.7	1860	0	68470	4545	2870	23780	0	18.8	3.3	0	0.1	0	0
YC-02	5/30/13	5.08	0	0	49930	8780	19.7	1976	0	67610	4542	2884	24430	0	27.3	3.7	0	0.08	0	0
YC-03	5/30/13	4.6	0	0	53930	8776	21.8	2132	0	69980	3207	2881	24390	0	29.9	3.4	0	0.05	0	0
YC-04	5/30/13	4.68	0	0	62790	9317	19.3	2193	0	77540	3460	3117	26350	0	21.6	2.4	0	0.07	0	0
YC-05	5/30/13	4.99	0	0	68410	9397	33.9	2412	0	78850	3544	3174	26340	0	39.7	3.1	0	0.12	0	0
YC-06	5/30/13	4.77	0	0	93600	9278	45.2	2517	4.8	92460	1925	3047	28110	0	59.4	4	0.06	0.16	0	0
YC-07	5/30/13	5.06	0	0	94540	9326	46.8	2524	4.3	93100	1890	3066	28210	0	63.8	4.3	0.06	0.12	0	0
YC-08	5/30/13	5.02	0	0	29180	14300	16.9	2454	0	102300	601.8	3727	37790	0	20.5	1.1	0.06	0.15	0	0
CC-01	6/24/13	7.02	0	0	41500	25260	7.5	2356	0	237700	2043	4374	60630	0	16.4	1.7	0	0.72	0	0
CC-02	6/24/13	7.19	0	0	41830	25850	7.7	2346	0	242700	1900	4436	61290	0	12.7	1.7	0	0.72	0	0
CC-03	6/24/13	7.18	0	0	45180	27750	8.2	2341	0	264900	1759	4682	64940	0	12.9	1.9	0.05	0.82	0	0
CC-04	6/24/13	33.65	0	0	48900	26440	17.1	2342	371.9	260900	1745	5086	63800	13.63	146.7	5	0.25	8.96	7.93	0
CC-05	6/24/13	10.99	0	0	63690	22860	13.5	2565	73.9	227300	12040	4339	51170	0	27.7	3.6	0.05	0.69	0.26	0
CC-06	6/24/13	7.82	0	0	62960	21850	28.5	2567	0	231000	2821	3878	52940	0	68.5	12.3	0.1	0.71	0.28	0
CC-07	6/24/13	6.66	0	0	62150	16430	17.8	2601	0	201800	3049	3437	45230	0	42.8	6.2	0.06	0.52	0	0
CC-08	6/24/13	7.75	0	0	58810	15740	12.2	2788	0	193400	2803	3318	43340	0	24.4	3.5	0	0.52	0	0
CC-09	6/24/13	8.14	0	0	54060	17130	35	2648	0	198300	2540	3415	48080	0	110.5	19.2	0.15	0.67	0.16	0
CC-10	6/24/13	7.07	0	0	45890	16970	10.2	2622	0	186300	2227	3228	47310	0	30.2	6.6	0	0.63	0	0
CC-11	6/24/13	6.3	0	1.57	279300	21480	18.1	2243	0	613200	5698	6267	50820	0	0	1.2	0.09	0.61	0	0
CC-12	6/24/13	6.46	0	0	63040	21880	9.5	2565	0	235700	2997	3904	53850	0	14.4	1.7	0	0.42	0	0

CC-13	6/24/13	6.88	0	0	36740	32990	6.3	2214	0	306200	782.4	5650	78040	0	0	3.9	0.06	1.23	0	0
CC-14	6/24/13	6.87	0	0	37790	33650	5.8	2230	0	312800	750.8	5767	79660	0	0	2.6	0	1.37	0	0
CC-15	6/24/13	7.65	0	0	38980	34570	6.4	2192	0	324000	570.1	5933	81670	0	0	5.1	0.05	1.74	0	0
LCVA-01	6/24/13	4.72	0	0	65350	28840	6.4	2585	0	247400	5188	3862	64050	0	14.4	2.1	0	0.25	0	0
LCVA-02	6/24/13	5.13	0	0	64890	28720	22.1	2567	0	246000	5297	3838	64120	0	68.2	18.7	0.09	0.38	0	0
LCVA-03	6/24/13	4.7	0	0	66390	29300	5.3	2577	0	252000	5335	3913	65470	0	13	1.8	0	0.29	0	0
LCVA-04	6/24/13	4.85	0	0	66030	29760	6.1	2517	0	254400	5132	3941	65710	0	30.2	2.9	0	0.35	0	0
LCVA-05	6/24/13	4.91	0	0	70740	26340	5.4	2671	0	231600	5246	3735	62120	0	7.4	23.3	0	0.33	0	0
LCVA-06	6/24/13	4.99	0	0	73270	23110	8.5	2648	0	205200	5738	3568	55860	0	24.4	116.7	0	0.19	0	0
LCVA-07	6/24/13	4.63	0	0	95240	24480	0	2917	0	226300	3667	3803	60670	0	29.5	192.8	0	0.17	0	0
LCVA-08	6/24/13	5.25	0	0	35050	20280	22.7	2346	0	167900	6820	3152	46530	0	59.4	11.6	0.08	0.45	0	0
RF-01	6/24/13	0	0	0	54250	46040	8.6	2290	0	405300	1445	5303	92120	0	10.9	4.6	0.1	1.08	0	0
RF-02	6/24/13	5	0	1.57	54980	46360	8.4	2309	0	408800	1384	5371	93090	0	67.2	13.1	0.13	1.24	0	0
RF-03	6/24/13	5.2	0	0.84	50300	47430	10.9	2240	0	415700	1267	5431	96490	0	20.8	11.6	0.13	1.31	0	0
RF-04	6/24/13	4.71	0	0.81	51880	48060	7.2	2208	0	429400	1283	5519	99890	0	0	10	0.13	1.32	0	0
RF-05	6/24/13	5.19	0	0	52430	48120	7.2	2174	0	432800	1190	5559	100900	0	0	19.7	0.16	1.51	0	0
RF-06	6/24/13	5.52	0	0	68840	34070	8.7	2438	0	353800	1673	4954	77730	0.11	20.4	11.9	0.07	1.4	0	0
RF-07	6/24/13	5.86	0	0	39140	55370	62.5	2140	0	473700	837.1	5560	110900	0	204.6	65.2	0.4	1.7	0	0
RF-08	6/24/13	6.86	0	0	67020	33410	77.9	2473	0	370500	1687	4999	80770	0	371.1	75.8	0.45	1.49	0.35	0
RF-09	6/24/13	5.2	0	0	73730	38170	19.6	2309	0	432500	1520	5545	91960	0	29.3	41.8	0.3	1.58	0	0
LCKY-01	6/25/13	9.25	0	0	76590	8474	267.4	2492	13.8	74230	5695	2908	24830	0.06	447.1	103.3	0.3	0.54	0.87	0
LCKY-02	6/25/13	8.41	0	0	17700	8166	130.6	2207	0	55010	5302	2229	22920	0.05	237.7	19.5	0.28	0.38	0.35	0
LCKY-03	6/25/13	6.33	0	0	17460	7972	13.9	2135	0	55300	5502	2225	22340	0	10.2	1.5	0	0	0	0
LCKY-04	6/25/13	6.62	0	0	15830	8098	14.9	2101	0	55180	6337	2278	22000	0	12.1	1	0	0.06	0	0
LCKY-05	6/25/13	6.47	0	0	15740	8251	11.6	2075	0	56820	6737	2348	22430	0	0	0.8	0	0	0	0
LCKY-06	6/25/13	4.99	0	0	19290	6390	8	1951	0	40720	16270	1721	16420	0	0	0.8	0	0	0	0
YC-01	6/25/13	4.88	0	0	39140	7834	35.6	2334	0	56850	3648	2603	22520	0	35.2	2.9	0	0.08	0	0
YC-02	6/25/13	4.85	0	0	40180	8108	31.3	2426	0	57100	3501	2646	23300	0	23.5	2.1	0	0	0.72	0
YC-03	6/25/13	4.57	0	0	40060	7846	32.2	2411	9.7	53240	2445	2504	22240	0	42.4	1.8	0	0	0	0
YC-04	6/25/13	4.75	0	0	47630	8752	26.4	2533	0	63440	2344	2786	24970	0	18.7	1.4	0	0	0	0
YC-05	6/25/13	6.95	0	0	51650	8805	21.1	2582	0	64930	2412	2829	24890	0	15.7	1.6	0	0.06	0	0
YC-06	6/25/13	4.89	0	0	79560	9019	25.6	2542	0	78410	1693	2904	27580	0	23.9	2.5	0	0	0	0
YC-07	6/25/13	5.58	0	0	79820	9014	27.1	2540	0	79060	1690	2913	27770	0	25.1	2.2	0	0.09	0	0
YC-08	6/25/13	4.9	0	0	21150	11230	13.9	2549	0	73560	479.1	3060	30600	0	10.7	0.9	0	0.14	0	0

CC-01	7/22/13	0	0	0	47650	28540	29.8	2961	0	232000	2038	4808	63000	1.5	65.9	11.1	0	0.88	0	0
CC-02	7/22/13	0	0	0	48020	28730	62.5	2892	0	237900	1797	4773	63150	1.44	174.9	40.2	0.15	1.13	0	0
CC-03	7/22/13	0	0	0.84	57360	31590	57.8	2832	0	266600	1657	5286	69890	1.41	160.2	31.7	0.13	1.29	0	0
CC-04	7/22/13	0	0	0.96	61690	30310	57.5	2863	0	275100	1742	5277	68720	1.39	148.9	29.2	0.12	1.3	0	0
CC-05	7/22/13	0	0	0	75900	25700	54	3086	0	254900	2428	4490	58110	1.33	121.3	25	0.07	1.05	0	0
CC-06	7/22/13	0	0	0	77490	26230	25.6	3118	0	259500	2381	4558	58170	1.57	28.7	2.4	0	0.82	0	0
CC-07	7/22/13	0	0	0	76210	16940	68.3	3234	0	198800	2593	3908	46100	1.39	138.2	23.8	0.05	0.76	0	0
CC-08	7/22/13	0	0	0	78640	17110	73.7	3220	4	202600	2656	3922	46910	1.53	181.8	33.5	0.13	0.84	0	0
CC-09	7/22/13	0.92	0	0	189800	18450	74.6	3068	3.8	330200	4236	5129	48320	2.05	118.7	25.3	0.13	0.85	0	0
CC-10	7/22/13	0	0	0	50440	18030	54.8	3210	0	178100	1945	3674	48390	1.33	139.9	32.1	0.09	0.81	0	0
CC-11	7/22/13	0	0	1.63	332500	19100	95.6	2938	0	515300	7110	6384	53170	2.41	66.3	7.8	0.11	0.75	0	0
CC-12	7/22/13	0	0	0	74340	26890	23.7	3114	0	252900	2414	4620	59660	1.61	30.9	3.4	0	0.88	0	0
CC-13	7/22/13	0.64	0	1.21	47980	36060	59.8	2556	3.4	314800	762.9	6243	82170	1.51	169.9	30.5	0.16	2.03	0	0
CC-14	7/22/13	0.56	0	0	50190	37280	51.7	2547	0	321300	654.2	6439	84180	1.54	145.3	31.1	0.17	2.09	0	0
CC-15	7/22/13	2	0	0	53160	38480	75	2527	0	339600	553.8	6615	88320	1.43	238.3	55.4	0.32	2.77	0	0
LCVA-01	7/22/13	0	0	0	72930	34530	33.1	3026	0	254100	4464	4451	71030	2.32	136.1	46.7	0.06	0.73	0	0
LCVA-02	7/22/13	0	0	0	76920	36360	26.9	3007	0	257500	4373	4697	74550	2.12	108.4	45.1	0	0.61	0	0
LCVA-03	7/22/13	0	0	0	75690	36760	17.5	2954	0	266000	4514	4642	73930	2.09	69.8	24.3	0	0.69	0	0
LCVA-04	7/22/13	0	0	0	75710	37600	22.8	2892	0	281100	4418	4642	75180	2.1	101.8	50.8	0	0.82	0	0
LCVA-05	7/22/13	0	0	0	84800	31660	3.8	3033	0	259300	4979	4334	69780	1.98	12	19.1	0	0.58	0	0
LCVA-06	7/22/13	0	0	0	87430	28160	10.6	2952	0	233200	5695	4148	63690	2.2	48.6	129.6	0	0.42	0	0
LCVA-07	7/22/13	0	0	0	114600	29290	0.6	3395	9.3	238200	3701	4405	67090	1.87	39.3	207.7	0	0.34	0	0
LCVA-08	7/22/13	0	0	1	47470	28630	14.3	2523	0	218600	6638	4164	62700	3.07	53	8.6	0	0.65	0	0
RF-01	7/22/13	0	0	1.21	73780	50800	10.8	2665	0	386600	1710	6113	95460	1.64	33.9	3.4	0	1.2	0	0
RF-02	7/22/13	0	0	2.32	73310	50130	26.2	2684	0	403800	1628	5999	93970	1.49	161.3	49.3	0.25	1.53	0	0
RF-03	7/22/13	0	0	1.66	70470	53850	9.3	2639	0	416400	1457	6322	101800	1.77	54.5	12.3	0.05	1.58	0	0
RF-04	7/22/13	0	0	1.06	72390	51700	36.6	2567	7.5	429100	1534	6107	100500	2.32	187.6	67.6	0.27	1.79	0	0
RF-05	7/22/13	0	0	1.06	77610	54830	29.1	2571	0	438400	1386	6522	107200	1.63	148.6	62.6	0.21	1.96	0	0
RF-06	7/22/13	0	0	0	70650	57000	8.5	2533	0	471400	1193	6152	107700	1.56	39.6	32.4	0.08	1.69	0	0
RF-07	7/22/13	0	0	0	64740	63150	30.8	2409	0	544600	995	6200	118000	1.58	176.8	90	0.32	1.6	0	0
RF-08	7/22/13	0	0	0	81890	32870	37.8	2835	0	339000	2103	5369	73530	1.32	140.9	41.9	0.17	1.26	0	0
RF-09	7/22/13	0	0	0.93	101800	43150	35.1	2635	0	434800	2072	6606	96250	1.69	57.1	54.2	0.29	1.73	0	0
LCKY-01	7/23/13	0	0	0	101100	10010	33.6	2841	29.1	78640	7108	3485	27150	1.75	74.6	15.5	0	0.18	0	0
LCKY-02	7/23/13	0	0	0	20230	8663	41.4	2311	0	50160	4923	2524	23770	1.19	61.7	12.3	0	0.21	0	0

LCKY-03	7/23/13	0	0	0	20100	8673	17.9	2291	0	49740	4954	2571	23630	1.23	14.1	0.6	0	0.13	0	0
LCKY-04	7/23/13	0	0	0	18370	8549	14.3	2281	0	51640	5635	2558	23030	3.41	36.6	1	0	0.32	0	0
LCKY-05	7/23/13	0	0	0	17900	8313	18.7	2301	0	53580	5967	2449	22220	1.05	20.7	1.6	0	0.16	0	0
LCKY-06	7/23/13	0	0	0	17460	8308	13.6	2231	0	53020	6089	2472	22090	1.03	9.1	0.6	0	0.13	0	0
YC-01	7/23/13	0	0	0	43710	10200	104.8	2687	0	65710	3165	3180	27870	1.48	128.8	13.8	0.06	0.32	0	0
YC-02	7/23/13	0	0	0	46740	10640	50.6	2762	0	68160	3172	3238	28860	1.34	41.6	2.6	0	0.21	0	0
YC-03	7/23/13	0	0	0	49370	10270	128.3	2753	5.9	66020	2296	3108	27520	1.71	184.5	24.6	0.13	0.44	0	0
YC-04	7/23/13	0	0	0	56170	10510	174.5	2775	6.1	74000	2280	3239	29110	3.37	224.7	27.3	0.23	0.53	0	0
YC-05	7/23/13	0	0	0	64630	10710	95.5	2772	7	79910	2482	3318	29510	1.87	128	18.1	0.08	0.37	0	0
YC-06	7/23/13	0	0	0	17860	2554	62.7	707.9	0	19750	0	1282	14600	0.65	197.2	33.4	0.23	0.4	0	0
YC-07	7/23/13	0	0	0	17320	2473	58.4	713.9	0	21240	0	1216	14330	1.18	186.3	28.9	0.21	0.37	0	0
YC-08	7/23/13	0	0	0	5936	3365	29	714.8	0	20520	0	1460	16430	0.44	86.7	16.7	0.13	0.4	0	0
CC-01	8/19/13	5.63	0	1.1	67600	36250	27.8	2611	0	300900	2543	5797	79090	1.56	82.2	8.7	0	0.87	0	0
CC-02	8/19/13	5.94	0	2.48	65740	35460	29.9	2623	0	308200	2262	5609	76780	0.9	82.8	17.5	0.06	0.97	0	0
CC-03	8/19/13	5.78	0	0.96	74860	39220	33.9	2642	0	331000	2266	6206	84650	1	72	17.6	0	1.18	0	0
CC-04	8/19/13	6.03	0	1.31	81160	37100	33.2	2691	0	334900	2381	6281	82930	1.01	71.3	8.8	0	1.15	0	0
CC-05	8/19/13	5.61	0	1.87	98680	34820	25.4	2793	0	327200	3510	5400	74490	1.22	56.7	5.5	0	1.01	0	0
CC-06	8/19/13	5.81	0	1.51	100700	35730	31.2	2790	0	325300	3528	5564	76000	1.41	69.5	3.2	0	0.9	0	0
CC-07	8/19/13	5.7	0	0	115300	20680	34.3	2818	4.9	250800	4564	4770	55840	1.01	78.3	5	0	0.7	0	0
CC-08	8/19/13	5.63	0	0	126600	21410	35.2	3014	6.4	271300	4837	4934	57500	1.56	101.6	8.1	0	0.64	0	0
CC-09	8/19/13	6.02	0	0	160400	21630	51.8	3061	4.1	325400	5529	5180	56860	1.24	137.4	29.5	0	0.71	0	0
CC-10	8/19/13	5.33	0	0	72960	22600	23	3202	0	247600	4124	4348	61400	0.87	107.1	45.3	0	0.78	0	0
CC-11	8/19/13	5.97	0	1.23	379500	19620	43.1	2541	0	541000	8803	6701	43940	2.15	26.3	3	0	0.63	0	0
CC-12	8/19/13	5.61	0	2.62	93970	35850	26.7	2770	0	327900	3347	5427	75100	0.98	61.8	4.3	0	1	0	0
CC-13	8/19/13	7.39	0	1.06	56880	42760	70	2524	4.2	368300	1153	7139	95800	1.03	190.3	43.1	0.2	2.15	0	0
CC-14	8/19/13	7.09	0	1.31	59690	44070	54.3	2506	0	366000	953.3	7482	98840	1	121.7	29.3	0.12	2.23	0	0
CC-15	8/19/13	6.26	0	1.59	63670	45430	27.6	2530	0	391700	874.7	7600	100400	0.93	37	16.4	0	2.32	0	0
LCVA-01	8/19/13	5.65	0	0	87770	39600	14.4	3141	4.8	298600	4523	4852	82390	1.21	41.1	5.7	0	0.64	0	0
LCVA-02	8/19/13	5.48	0	0	90370	40840	16.6	3141	5.1	290200	4493	5081	85130	1.26	43.3	5.5	0	0.67	0	0
LCVA-03	8/19/13	5.78	0	0	89200	40870	20	3112	5.8	295100	4448	5017	84770	1.26	59.7	24.8	0	0.7	0	0
LCVA-04	8/19/13	5.44	0	0	89510	40740	15.7	3102	5.3	303900	4507	4976	84970	1.23	43.8	10.7	0	0.65	0	0
LCVA-05	8/19/13	5.63	0	0	98550	35460	13	3124	5.5	273000	4414	4780	79190	1.29	23.2	34	0	0.7	0	0
LCVA-06	8/19/13	5.5	0	0	95690	31090	19.6	2981	5.6	245500	5291	4488	70790	1.83	77.2	144.9	0	0.45	0	0
LCVA-07	8/19/13	5	0	0	116700	30650	4.2	3462	9.7	249600	3606	4502	70220	1.45	46.7	219.4	0	0.33	0	0

LCVA-08	8/19/13	5.33	0	0	54360	31940	46.6	2398	3.9	251700	6203	4524	69400	0.96	90.6	16.8	0	0.68	0	0
RF-01	8/19/13	5.9	0.38	4.28	89760	53200	23.6	2561	3.5	469600	2622	6189	96350	1.04	134.6	33.9	0.17	1.11	0	0
RF-02	8/19/13	5.27	0	3.34	91950	54950	20.6	2628	0	470500	2561	6388	100800	1.03	137.4	45.4	0.17	1.16	0	0
RF-03	8/19/13	5.49	0	2.63	85990	58610	18.9	2514	0	483200	2236	6704	109400	2.85	95.9	30	0.17	1.44	0	0
RF-04	8/19/13	5.74	0	2.17	89860	58330	31	2453	0	502200	2084	6715	111700	1.38	145.7	49	0.22	1.5	0	0
RF-05	8/19/13	6.43	0	2.81	92270	59600	43.1	2464	0	522800	2207	6745	114800	1.08	163.1	63.9	0.25	1.71	0	0
RF-06	8/19/13	6.43	0	2.88	106300	41190	27.6	2689	0	420500	2774	5950	84460	1.07	72.3	21.1	0	1.71	0	0
RF-07	8/19/13	7.39	0	0	78160	67040	78.7	2438	6.5	553600	1284	6567	126100	1.14	660.2	141.8	0.5	1.69	0	0
RF-08	8/19/13	6.08	0	2.02	115800	40390	35.4	2594	0	441700	3093	6532	88590	0.9	125.8	25	0.12	1.11	0	0
RF-09	8/19/13	5.59	0	3.09	130700	47770	37.7	2515	0	537900	3092	7392	105000	1.04	118.5	64.3	0.3	1.67	0	0
LCKY-01	8/20/13	5.98	0	0	130400	10230	27.6	2888	9.7	85650	7326	3744	28690	2.03	151.5	44	0	0.26	0	0
LCKY-02	8/20/13	6.99	0	0	20620	9325	61.7	2300	0	53460	4952	2622	25770	0.65	81.1	11.4	0	0.25	0	0
LCKY-03	8/20/13	4.92	0	0	19520	9147	36	2312	0	54370	4943	2569	25080	0.8	29.8	2.8	0	0.15	0	0
LCKY-04	8/20/13	5.56	0	0	17850	9447	63.6	2260	0	56740	5714	2672	25280	0.57	129.1	7.7	0	0.27	0	0
LCKY-05	8/20/13	6.27	0	0	17880	9131	103.5	2287	3.8	56030	5360	2550	24440	0.61	172.5	22.9	0.15	0.43	0	0
LCKY-06	8/20/13	5.86	0	0	17660	9218	75.5	2258	3.6	58130	6218	2569	24660	0.51	158.2	13.9	0.08	0.29	0	0
YC-01	8/20/13	6.59	0	0	58440	10040	62.4	2471	3.7	65900	4729	3428	28730	0.89	76.6	8.1	0	0.32	0	0
YC-02	8/20/13	5.66	0	0	61930	10280	70.9	2528	4.5	65040	4507	3485	29010	0.94	64.1	7.4	0	0.34	0	0
YC-03	8/20/13	6	0	0	66060	10000	104.3	2705	6.1	67340	3269	3303	27530	1	113.8	15.6	0.05	0.29	0	0
YC-04	8/20/13	6.1	0	0	76360	10560	123.7	2780	7.3	74610	3502	3524	29110	1.13	137.4	18.2	0.09	0.39	0	0
YC-05	8/20/13	5.81	0	0	86390	10770	172.8	2932	12.3	76230	3521	3596	29220	1.3	224.7	24.2	0.17	0.54	0	0
YC-06	8/20/13	7.37	0	0	111600	10560	285.1	2965	20.8	88310	2550	3352	30680	1.56	406.9	45.9	0.39	0.76	0	0
YC-07	8/20/13	6.91	0	0	112900	10530	296.5	2956	21.2	88680	2257	3343	31040	1.85	374.4	48.9	0.45	0.74	0	0
YC-08	8/20/13	8.43	0	0	36180	15820	188.2	2879	5.9	96430	839.3	4090	38370	1.01	293.6	29.3	0.44	0.95	0	230969
CC-01	9/25/13	5.22	0.88	1.82	96480	40660	15.5	2591	0	335300	2463	6048	79880	0.32	108.1	11.8	0.08	0.7	0.34	225493
CC-02	9/25/13	4.51	1.14	1.43	96570	40990	15.4	2643	0	346600	2134	6096	80680	0.32	80.4	12.9	0.12	0.92	0.31	222302
CC-03	9/25/13	7.13	1	1.71	99310	41140	8.7	2648	0	378600	2075	6234	80700	0.33	44.9	11.5	0.07	0.82	0.47	217043
CC-04	9/25/13	5.39	0.87	1.34	112500	38930	22.1	2621	0	353900	2127	6324	79210	0.33	56.8	7.9	0.07	0.67	0	231915
CC-05	9/25/13	5.28	0.67	2.63	106800	39640	22.6	2677	0	330400	2871	5908	78210	0.27	46.2	6.8	0.05	0.86	0.25	237684
CC-06	9/25/13	5.25	0.75	1.67	108300	41160	29.5	2674	0	327600	2994	6008	77830	0.49	41.4	7.9	0.09	0.9	0.31	211475
CC-07	9/25/13	5.91	0.61	0	102600	25760	43.7	2613	0	240600	6905	4982	59520	0.2	84.3	11.3	0.09	0.36	0.28	195286
CC-08	9/25/13	5.7	0.62	0	105800	25280	32	2827	8.2	234600	14430	5002	59930	0.34	90.5	10.2	0.06	0.39	0.16	185484
CC-09	9/25/13	5.5	0.5	0	107100	26160	22.6	2840	9	247300	10730	5106	61680	0.4	100.6	24.3	0.05	0.63	0.16	185007
CC-10	9/25/13	5.49	0.54	0	89150	27030	23.8	2876	3.5	235400	9961	4987	63160	0.2	119.1	36.4	0.08	0.43	0.11	196083

CC-11	9/25/13	4.97	0.63	0	394100	17370	12.5	2032	0	412800	10310	6646	31330	0.99	9.1	2.8	0.11	0.52	0	188865
CC-12	9/25/13	5.2	0.96	2.66	106200	40710	31.5	2693	0	331900	2813	5965	79460	0.26	58.2	11.3	0.08	0.75	0.35	196266
CC-13	9/25/13	5.96	0.67	0	90810	41720	15.2	2335	0	400600	0	7050	89730	0.18	41.3	4.6	0.06	1.4	0.18	227286
CC-14	9/25/13	6.12	0.65	0	91090	41980	25.4	2366	0	402300	0	7088	89730	1.87	65.2	7.8	0.09	1.43	0.32	222548
CC-15	9/25/13	10.12	0.84	0	92350	43790	211.4	2663	12.7	411800	0	7215	110700	0.61	745.2	84.2	0.56	2.74	1.3	203167
LCVA-01	9/25/13	5.08	0.42	0	104700	41070	20.5	3402	9.1	306800	3057	4793	82230	0.38	101.1	31.2	0.11	0.61	0	209752
LCVA-02	9/25/13	5.11	0.51	0	105000	40240	20.5	3401	0	305900	2944	4851	83560	0.26	73.7	22.4	0.08	0.5	0.14	220719
LCVA-03	9/25/13	4.75	0.36	0	106900	41150	11	3431	9.5	306400	2989	4934	84810	0.44	51	15.5	0.06	0.63	0	193692
LCVA-04	9/25/13	4.81	0.36	0	108900	41050	19.5	3401	10.1	306900	2777	4983	87860	0.34	74.6	32.2	0.07	0.48	0	477045
LCVA-05	9/25/13	5.22	0.39	0	115800	38000	15	3408	13.1	272300	2672	4784	82190	0.43	95	88.6	0.1	0.38	0	208244
LCVA-06	9/25/13	6.24	0.31	0	119600	35960	7	3401	13.2	256200	3016	4752	78370	0.6	44.9	220.7	0.07	0.2	0	171792
LCVA-07	9/25/13	4.9	0.67	0	120600	34550	0	3437	14	248400	2584	4642	74870	0.5	41.3	238.5	0	0.24	0	186209
LCVA-08	9/25/13	4.91	0.61	0	87500	47480	26.7	2481	3.6	393700	6195	5708	99910	0.18	177.1	32.5	0.19	0.7	0	179934
RF-01	9/25/13	5.13	2.63	2.46	117100	62710	2.9	2658	0	533300	1196	6680	108900	0.23	92	17.9	0.13	1.16	0.2	249315
RF-02	9/25/13	5.38	2	1.37	119800	64810	12.4	2719	0	516800	1080	6872	113500	2.08	133.1	35.5	0.16	1.14	0.33	264202
RF-03	9/25/13	4.96	2.21	1.8	101500	64540	24.3	2491	10.3	541500	754.4	6780	112000	0.55	123.4	32.5	0.17	1.35	0.25	278810
RF-04	9/25/13	6.11	1.34	1.38	107200	67350	3.7	2470	0	578400	758.7	7065	120000	0.24	96	27.6	0.17	1.44	0	260783
RF-05	9/25/13	5.77	1.32	2.12	109400	68250	13.8	2481	0	573100	714.5	7113	122600	0.23	128.5	54.3	0.19	1.58	0.19	287903
RF-06	9/25/13	6.79	1.09	1.74	124100	48520	1.7	2722	0	461900	1540	6592	94010	0.68	117	32.6	0.1	1.75	0.18	281383
RF-07	9/25/13	4.94	0.99	0	100900	73540	16.7	2454	0	616900	150	6817	128300	0.42	213.6	95.9	0.28	1.18	0.13	292550
RF-08	9/25/13	2.95	0.98	0	130600	43740	7.7	2626	3.4	506000	2199	6808	92490	0.15	114.6	25.1	0.11	0.98	0.17	185837
RF-09	9/25/13	5.68	0.87	1.67	142000	51190	12.1	2423	0	592100	1964	7600	107000	0.12	148	70.7	0.19	1.4	0	283713
LCKY-01	9/26/13	5.33	0.69	0	204800	12010	15.5	3276	22.4	107600	8429	4429	31570	0.75	163.1	39.8	0	0.11	0	95486
LCKY-02	9/26/13	7.57	0.37	0	35400	11060	7.1	2063	0	78190	4373	2727	31380	0.69	10.1	3.4	0	0.16	0.13	83586
LCKY-03	9/26/13	7.58	0.38	0	31550	10980	13.9	2021	0	80340	4382	2648	29820	1.2	22	3.7	0	0.2	0	73983
LCKY-04	9/26/13	5.44	0.34	0	31390	11460	10.9	2025	3.8	89940	4940	2774	30160	0	8.2	2.3	0	0.23	0	75119
LCKY-05	9/26/13	5.76	0.34	0	32270	11960	7.7	2034	0	89780	4786	2856	31200	0	7.4	3.1	0	0	0	57101
LCKY-06	9/26/13	5.54	0.31	0	30750	11750	5.9	1977	0	90370	4971	2850	31100	0.17	0	1.7	0	0.16	0	226566
YC-01	9/26/13	5.06	0.5	0	111300	11210	12.1	2396	4.3	77040	6989	3809	28350	0.51	29.1	3.3	0	0.26	0.44	218645
YC-02	9/26/13	5.15	0.5	0	117700	11190	17.4	2501	4.6	72670	7091	3798	28100	0.4	27.8	3.1	0	0.07	0.19	263592
YC-03	9/26/13	5.09	0.83	0	132000	10890	26.1	2641	10.1	75080	5027	3638	26210	0.5	32.2	4.1	0.08	0.32	0.1	277234
YC-04	9/26/13	5.12	0.78	0	141800	11110	25.2	2708	13.8	77440	4810	3690	26800	0.39	28.2	3.7	0.05	0.15	0	293423
YC-05	9/26/13	27.32	0.63	0	149900	11150	24.4	2918	16.9	80210	4696	3675	26300	0.68	22.2	3.4	0	0.33	41.5	356603
YC-06	9/26/13	6.67	0.82	0	198200	9701	155	3052	31.6	81590	3751	3245	25230	0.68	229.5	33.5	0.28	0.5	0.49	366050

YC-07	9/26/13	4.94	0.77	0	204000	9806	49.2	3047	28	85040	3878	3292	24920	0.79	47.4	5.6	0.06	0	0.11	201370
YC-08	9/26/13	5.91	0.45	0	64570	23330	28.5	2805	6	135000	30.43	5224	47330	0.28	20.9	5.9	0.09	0.3	0	242407
CC-01	10/23/13	4.3	0.38	2.25	72060	40880	26.1	2534	0	342700	1790	6503	81790	0	61.3	4.5	0.07	0.65	0.15	236399
CC-02	10/23/13	4.58	0.32	1.28	71600	39800	32.3	2546	0	346700	1289	6559	82670	0	79.3	12.8	0.14	1.03	0.28	249794
CC-03	10/23/13	4.6	0.86	3.26	76260	42410	18.9	2529	0	374800	1303	6867	86190	0.05	30.9	3.5	0.08	1.03	0.16	209573
CC-04	10/23/13	4.5	0.58	3.15	81740	41130	24.3	2516	0	369500	2925	7112	86570	0	39.5	4.5	0.08	1.14	0.2	253598
CC-05	10/23/13	4.39	0.45	2.32	103600	38300	39.3	2828	0	327300	5411	5669	74470	0	37.4	0.9	0.05	0.71	0	260574
CC-06	10/23/13	5	0.49	1.74	102800	37920	105.7	2820	0	326100	4998	5614	75090	0	105.4	18.4	0.09	0.8	0.28	234047
CC-07	10/23/13	4.69	0.46	0	98430	26240	109.6	2803	0	250500	5259	4860	60500	0	105.4	15.8	0.09	0.41	0.17	221867
CC-08	10/23/13	4.85	0.46	0	100800	26580	66.9	2868	4.8	255000	4986	4932	61380	0.07	87.4	11.5	0.06	0.55	0	210715
CC-09	10/23/13	5.08	0.36	0	112100	27200	45.3	2856	6.2	268700	4926	5115	61980	0.08	79	17.7	0.05	0.61	0.2	218721
CC-10	10/23/13	5.27	0.37	0	76680	28220	86.9	2928	3.3	243800	3707	4788	64590	0	149.8	34.5	0.1	0.44	0	228073
CC-11	10/23/13	4.65	0.42	0	382400	17720	8.3	2097	0	446200	9494	6691	34300	0.1	10.9	1	0.11	0.46	0.12	216800
CC-12	10/23/13	5.59	0.39	2.07	100400	38430	134.7	2868	5.6	327100	4768	5658	75610	0	165.2	25.8	0.16	0.77	0.56	250738
CC-13	10/23/13	4.4	0.76	3.57	53970	50140	10	2271	0	423600	0	8537	105000	0	18.5	2.7	0.07	1.65	0.19	255189
CC-14	10/23/13	6.13	0.73	2.89	55180	50760	83.7	2346	5.3	427100	0	8608	108600	0	224.6	25.6	0.25	2	0.37	249170
CC-15	10/23/13	4.89	0.58	2.98	56070	51670	101.9	2355	5.6	439100	0	8713	111100	0.07	273.2	23.9	0.28	2.43	0.51	217737
LCVA-01	10/23/13	4.58	0.47	0	98840	40670	12.2	3364	7.9	326100	3079	5075	83640	0	58.5	12.8	0.07	0.66	0.1	207341
LCVA-02	10/23/13	5.19	0.4	0	98840	40980	11	3362	7.5	326300	3149	5100	83680	0	50.8	10.4	0.06	0.54	0.15	220661
LCVA-03	10/23/13	5.39	0.35	0	101200	42040	41.5	3456	10.2	338200	3182	5212	86630	0	144.6	45.7	0.15	0.84	0.33	185080
LCVA-04	10/23/13	4.74	0.34	0	104400	42240	12	3417	9.4	337000	3117	5226	87720	0	52.2	15.6	0.06	0.52	0	593141
LCVA-05	10/23/13	4.47	0.27	0	110700	38680	34.4	3397	8.1	301800	3281	4864	82170	0	56.7	46.3	0.05	0.59	0	241027
LCVA-06	10/23/13	4.64	0.26	0	112200	35610	0.6	3339	10.7	280500	3782	4763	76950	0	29.1	182.8	0.05	0.53	0	209926
LCVA-07	10/23/13	4.1	0.25	0	124000	34610	0	3554	14.1	270600	2731	4716	75660	0	28.3	237.5	0.05	0.3	0	210785
LCVA-08	10/23/13	5.31	0.93	2.06	68990	41280	71.6	2577	5	353000	6684	5376	88520	0	265	51.8	0.19	0.97	0.27	195539
RF-01	10/23/13	4.41	0.38	0	104500	58030	8	2631	0	509300	995.6	6586	100400	0	88.1	19.8	0.13	0.95	0	290829
RF-02	10/23/13	4.55	0.79	2.31	105300	58480	18.9	2705	4.9	515400	950.5	6652	100800	0	155	51.4	0.19	1.12	0	326771
RF-03	10/23/13	4.75	0.6	0.99	96010	62600	14.1	2536	3.8	539200	726.1	6914	110300	0	109.1	44.5	0.21	1.49	0.33	302226
RF-04	10/23/13	4.88	0.59	1.45	100800	63390	8.8	2494	0	569200	762.9	7052	114000	0	75.3	33.2	0.15	1.36	0.16	309542
RF-05	10/23/13	6.98	0.44	1.7	102600	63650	8.1	2512	0	572000	757.3	7107	115400	0	79	48.6	0.17	1.44	0.77	324317
RF-06	10/23/13	7.63	0.4	4.22	126300	46290	9.9	2722	0	484200	1654	6900	94100	0	84.8	26.7	0.09	1.85	1.61	271692
RF-07	10/23/13	4.77	0.43	0	89300	71930	13.6	2432	0	619200	0	6903	125600	0	108.4	87.4	0.3	1.17	0	318142
RF-08	10/23/13	4.99	0.35	4.5	135500	44640	11.9	2626	0	529200	2090	7357	94530	0	68.6	20.7	0.11	1.18	0.11	209058
RF-09	10/23/13	5.17	0.37	5.35	149100	50660	19.5	2551	0	616500	2147	8181	110300	0	89.9	71.3	0.31	1.38	0.27	465676

LCKY-01	10/24/13	5.39	0.6	0	119700	10000	68.9	3043	21.9	82260	6663	3460	27230	1.17	238.1	46.2	0.12	0.49	0.29	101964
LCKY-02	10/24/13	5.52	0.52	0	23000	8230	93.4	2553	5.9	51610	4406	2394	23140	0.1	157.3	12.5	0.17	0.22	0.15	92846
LCKY-03	10/24/13	4.66	0.41	0	22220	8185	53.1	2494	0	52470	4685	2390	22550	0.81	98.7	8.5	0.09	0.33	0	90743
LCKY-04	10/24/13	4.56	0.36	0	21970	8316	40.3	2397	0	56650	5667	2430	22270	0	70.5	4.7	0.06	0.37	0	88340
LCKY-05	10/24/13	4.86	0.35	0	21260	8346	41.5	2354	0	56410	6048	2440	22110	0.56	69.9	5.3	0.08	0.22	0	83434
LCKY-06	10/24/13	4.58	0.31	0	20820	6145	50.9	2192	0	33390	13310	1796	15250	0	83.9	6.5	0.07	0.08	0	246103
YC-01	10/24/13	4.67	0.42	0	87500	11210	24.6	2564	6.6	77310	5879	3858	29740	0.64	152.7	4.5	0.09	0.47	0.47	281078
YC-02	10/24/13	3.85	0.55	0	93020	11270	21.7	2631	6.8	75610	5756	3829	29230	0	41	3.5	0.05	0.46	0.15	322127
YC-03	10/24/13	4.42	0.55	0	106000	11150	27.5	2821	9.7	76800	4050	3787	28550	0	41	3.6	0.05	0	0	326826
YC-04	10/24/13	4.32	0.98	0	117600	11440	42.8	2893	11.4	82940	3978	3880	28600	0.32	61.7	5.7	0.08	0.18	0.1	349914
YC-05	10/24/13	6.32	0.79	0	126500	11450	124.1	3142	15.8	84180	3826	3847	27400	0.19	202.5	18.2	0.24	0.3	0.38	438883
YC-06	10/24/13	4.34	0.7	0	161400	11060	40.4	3080	22.5	93450	3034	3621	28030	0.08	49.6	4	0.06	0.12	0	441212
YC-07	10/24/13	4.85	0.7	0	175600	10920	67.4	3143	24.3	97040	2787	3574	28550	0	91.9	7.3	0.09	0.15	0.26	218469
YC-08	10/24/13	5.15	0.46	0	57360	21750	27.2	3100	0	132800	0	5322	46250	0	37.4	2.1	0.1	0.48	0	244852
CC-01	11/13/13	5.9	0	1.59	90700	35520	3.1	2412	0	325500	3867	5481	74090	1.45	84.3	9.9	0.16	1.27	0.69	240817
CC-02	11/13/13	6.81	0	1.76	92490	35530	5.1	2413	0	319300	3413	5493	73970	1.4	78.3	7.6	0.14	1.31	0.73	244430
CC-03	11/13/13	6.27	0	1.7	97070	36990	2.1	2381	0	345600	3431	5588	75800	1.39	44.4	13.9	0.14	1.35	0.62	228844
CC-04	11/13/13	6.15	0	1.53	106200	34350	4.7	2356	4.9	332200	3272	5743	73600	1.53	51.9	7.9	0.14	1.33	0.61	267121
CC-05	11/13/13	6.19	0	2.7	110700	35350	4.8	2511	0	318000	4000	5318	70570	1.57	32.5	5.3	0.12	1.11	0.62	243492
CC-06	11/13/13	5.66	0	2.61	108300	34600	3	2550	15.3	323300	4350	5227	69220	1.65	46.2	5.2	0.12	1.14	0.47	236636
CC-07	11/13/13	5.85	0	0	109300	22370	6.9	2550	6.6	243500	5060	4524	54240	1.51	75.4	4	0.12	0.82	0.49	228091
CC-08	11/13/13	6.14	0	0	111300	22700	5.4	2676	6.4	241100	4782	4583	54970	1.46	91.6	13.2	0.12	0.91	0.47	213248
CC-09	11/13/13	6.18	0	0	116700	22650	3.6	2727	6.6	254400	4763	4551	54670	1.51	115.1	38.9	0.12	0.89	0.36	217686
CC-10	11/13/13	6.5	0	0	90420	24170	5	2760	3.7	233100	3790	4547	59190	1.36	134.7	54.5	0.12	0.97	0.42	214724
CC-11	11/13/13	5.38	0	1.76	410600	17120	3.6	2395	5.6	446500	11610	6591	31000	3.77	0	0.7	0.14	0.8	0.43	218323
CC-12	11/13/13	5.85	0	2.24	108400	35630	3.4	2507	0	319700	4352	5346	71630	1.45	35.9	4.8	0.12	1.13	0.63	228750
CC-13	11/13/13	6.77	0	1.09	78070	42410	1	2162	0	385900	1633	6894	92260	1.4	36.5	13.8	0.2	1.86	0.56	225955
CC-14	11/13/13	8.55	0	0	80920	44180	2.4	2219	0	391500	1353	7238	95350	1.28	44.3	13.7	0.17	1.98	0.67	261821
CC-15	11/13/13	7.74	0	1.13	81110	45230	7.5	2270	0	414800	1233	7376	99730	1.4	79.1	51	0.23	2.36	0.9	225519
LCVA-01	11/13/13	14.19	0	0	102800	38230	43.8	3355	11.5	279500	4198	4613	92090	1.93	307.6	104.7	0.35	1.37	0.86	209588
LCVA-02	11/13/13	10.89	0	0	100700	37290	4.1	3366	0	294400	4526	4471	83550	1.75	45.2	11.9	0.14	1.11	0.44	243698
LCVA-03	11/13/13	10.93	0	0	103500	38170	6.7	3404	0	295500	4464	4573	82760	1.92	53.5	19.3	0.17	1.13	0.38	206549
LCVA-04	11/13/13	11.83	0	0	102300	37650	5.4	3365	9	288900	4196	4547	86540	1.87	61.3	37.3	0.19	1.18	0.35	605904
LCVA-05	11/13/13	9.39	0	0	109100	33010	1.3	3341	8.7	255300	4122	4484	82590	1.98	40.6	19.3	0.14	1.05	0.33	242912

LCVA-06	11/13/13	7.23	0	0	111300	30390	1.2	3386	11.2	241500	4201	4378	69570	1.95	62.5	213.7	0.11	0.94	0.24	224862
LCVA-07	11/13/13	6.67	0	0	115800	30450	0	3413	11.8	230400	3855	4514	69700	2.43	29.8	230.7	0.1	0.87	1.54	209675
LCVA-08	11/13/13	13.14	0	0	85080	43560	160.3	2479	16.9	353300	7239	5141	90350	1.54	823.5	366.8	0.58	2.51	2.4	208179
RF-01	11/13/13	5.84	0	1.16	107400	56090	1.4	2451	0	483900	2442	6018	100400	1.49	65.8	23.1	0.21	1.63	1.2	320409
RF-02	11/13/13	5.88	0	1.2	109200	57330	1.3	2561	3.3	486700	2512	6152	103300	1.66	81.5	44.1	0.26	1.75	0.64	289045
RF-03	11/13/13	5.96	0	0	98200	61360	1.1	2391	0	504800	2249	6363	111100	1.43	81.5	46.9	0.28	2.03	0.68	278160
RF-04	11/13/13	6.03	0	1.66	97380	60790	0.8	2351	0	542100	2318	6262	112900	1.82	70.9	42	0.27	2	0.66	294873
RF-05	11/13/13	5.75	0	1.73	101800	62540	0.8	2411	0	537800	2235	6564	117700	1.55	61.3	69.1	0.32	2.15	0.68	287509
RF-06	11/13/13	6.58	0	1.91	119300	45080	0.5	2617	0	428300	3122	6239	90840	1.52	93.5	37.5	0.21	2.21	0.54	338434
RF-07	11/13/13	9.7	0	0	91560	66490	1.9	2316	0	571400	1654	6212	122600	1.49	60	114.5	0.4	1.99	0.74	329029
RF-08	11/13/13	6.17	0	1.67	127300	41420	1.5	2579	0	475000	3729	6395	90020	1.38	79.6	33.6	0.22	1.48	0.54	210380
RF-09	11/13/13	5.62	0	2.6	141400	48800	6.4	2515	0	565800	3729	7360	106900	1.48	53.5	141	0.45	2.11	0.65	287988
LCKY-01	11/14/13	7.55	0	0	154000	9579	7.9	2798	55.7	86300	8280	3727	26320	2.23	112	33.7	0.07	0.41	0.38	92628
LCKY-02	11/14/13	5.87	0	0	28350	9818	1.6	1885	0	64350	5225	2382	26350	0.73	0	7.8	0	0.4	0.21	84643
LCKY-03	11/14/13	6.44	0	0	25870	9559	3.7	1817	16.8	61990	4807	2353	25100	0.59	22.2	1.6	0	0.46	0.14	83626
LCKY-04	11/14/13	5.61	0	0	25340	10090	3.4	1892	0	72410	5732	2436	25750	0.53	0	1.1	0	0.32	0	87347
LCKY-05	11/14/13	5.7	0	0	25140	10180	2.1	1931	0	71520	5608	2497	26140	0.55	0	0.8	0	0.34	0	84921
LCKY-06	11/14/13	5.74	0	0	24500	10160	2.1	1829	0	69950	5590	2500	25930	0.52	0	5.6	0	0.38	0.1	232027
YC-01	11/14/13	5.07	0	0	98190	11080	2.2	1606	4	77050	7551	3481	29070	1.59	21.6	1	0.07	0.56	0.47	246520
YC-02	11/14/13	5.26	0	0	101700	10880	2.5	1850	3.9	76820	7780	3314	27980	1.67	16.4	1.5	0.08	0.47	0.42	326285
YC-03	11/14/13	5.65	0	0	117200	10820	3.5	2115	0	78550	5876	3303	27820	1.75	17.6	0.7	0.07	0.46	0.34	307092
YC-04	11/14/13	5.13	0	0	130700	11050	4.3	2266	0	83930	5848	3455	28350	2.02	0	0.9	0.07	0.46	0.28	334797
YC-05	11/14/13	5.9	0	0	137100	10740	4.1	2530	17.7	85990	5862	3466	26640	2.1	0	0.5	0.05	0.41	0.23	425286
YC-06	11/14/13	5.13	0	0	193900	11020	5.1	2876	17.7	105900	5591	3233	29240	2.89	0	0.9	0.07	0.49	0.28	450730
YC-07	11/14/13	6.4	0	0	198600	11030	7.3	2883	19.4	107700	5533	3264	30050	2.75	8.2	1.2	0.06	0.51	0.32	205206
YC-08	11/14/13	5.91	0	0	58820	19270	2.6	2543	0	109000	1387	4610	40940	1.35	0	0.7	0.07	0.58	0.17	157482
CC-01	12/12/13	6.69	0	2.92	36550	26650	18.5	2673	4.1	216300	2172	4544	58430	0.73	35.3	12.3	0.14	1.94	0.61	157954
CC-02	12/12/13	8.06	0	3.06	36570	26530	11.7	2591	3.4	214100	1995	4494	57500	1.54	18.5	2.4	0.09	1.81	0.51	152969
CC-03	12/12/13	6.86	0	3.43	40930	28610	15.5	2512	4.3	236600	1705	4794	61980	0.77	46.5	16.4	0.19	1.98	0.5	157770
CC-04	12/12/13	25.11	0	3.19	43690	28050	74.6	2552	10.5	232500	1711	4817	62640	0.82	274.2	109.4	0.84	3.1	1.31	159074
CC-05	12/12/13	6.84	0	2.14	57450	20930	15.2	2644	4.3	200700	2360	3710	47860	0.76	20.1	12.1	0.16	1.84	0.42	175013
CC-06	12/12/13	6.13	0	2.38	57760	21180	13.5	2629	0	203400	2285	3746	48070	0.82	8.5	4	0.09	1.79	0.38	163733
CC-07	12/12/13	6.72	0	1.43	58240	18260	19.5	2622	3.4	192200	2347	3503	44200	0.67	24.4	23.4	0.18	1.91	0.41	162379
CC-08	12/12/13	6.65	0	1.63	52590	17510	17.4	2823	0	182600	2184	3365	41910	0.66	18.7	12.5	0.11	1.8	0.37	157507

CC-09	12/12/13	5.96	0	5.08	203000	23270	16.2	2470	3.5	419100	3500	5614	55940	1.45	15.5	21.8	0.3	1.86	0.66	108138
CC-10	12/12/13	7.14	0	1.46	42220	19360	23.2	2609	4.6	180600	1780	3376	46090	0.69	21.3	47.2	0.3	2.3	0.39	113019
CC-11	12/12/13	5.11	0	9.88	326200	27670	6.2	2538	0	692000	5029	7547	60740	2.01	0	0.2	0.12	1.52	0.67	111728
CC-12	12/12/13	6.02	0	2.15	55340	20890	13.7	2710	0	199400	2409	3689	46610	0.76	0	4.1	0.09	1.55	0.35	123859
CC-13	12/12/13	6.25	0	4.35	31200	35890	5.9	2279	0	288700	1001	5836	76450	0.69	0	2.1	0.12	2.43	0.39	112954
CC-14	12/12/13	6.15	0	4.12	32580	37710	13.5	2262	3.7	297000	882.8	6170	80480	0.77	29.2	9.8	0.18	2.82	0.52	117774
CC-15	12/12/13	8.56	0	4.55	34290	38630	21.1	2185	3.5	305400	697.4	6324	83020	0.9	57.7	28.8	0.27	3.28	1.45	99642
LCVA-01	12/12/13	8.4	0	0	54480	27710	60.2	2950	12.5	188600	6206	3764	56300	1	237.7	107.5	0.31	1.31	0.73	107012
LCVA-02	12/12/13	6.05	0	0	55150	28070	15.7	2910	6.1	188200	6252	3844	57220	1.05	53.2	25.7	0.13	0.99	0.42	250597
LCVA-03	12/12/13	6.14	0	0.92	54980	27800	14.5	2907	8.7	199500	6459	3758	56510	1.04	53.4	26.4	0.12	0.95	0.35	102222
LCVA-04	12/12/13	8.22	0	0	56050	28310	56.9	2920	14.4	203800	6470	3786	57310	5.85	319.4	181.8	0.38	1.58	1.3	399876
LCVA-05	12/12/13	5.98	0	0	59030	25470	16.7	2873	8.1	185900	6486	3660	54080	1.16	66.9	53.8	0.15	0.94	0.32	115383
LCVA-06	12/12/13	5.88	0	0	60340	24730	17.9	2814	8.7	178000	7545	3685	53380	1.1	69.6	65.5	0.13	0.98	0.34	118791
LCVA-07	12/12/13	5.62	0	0	116800	29350	0	3418	13.1	226900	4322	4396	66890	2.08	0	220.5	0.1	0.87	0.17	134625
LCVA-08	12/12/13	6.72	0	0.99	31440	22460	43.2	2441	7.5	163500	7690	3283	45830	0.63	168.3	58.8	0.29	1.23	0.65	132451
RF-01	12/12/13	5.65	0	3.52	50240	47660	7.9	2406	0	349100	1636	5616	88080	0.98	14	4.7	0.16	1.86	0.59	159279
RF-02	12/12/13	7.15	0	3.51	49690	47270	25.5	2411	0	354000	1644	5512	87790	0.92	159.9	53	0.33	2	0.64	178593
RF-03	12/12/13	6.48	0	3.21	47660	49100	18.6	2346	3.9	363900	1469	5595	90750	1.03	83.1	29.8	0.29	2	1.09	167659
RF-04	12/12/13	6.72	0	4.57	51590	51850	15.1	2393	4.1	403600	1547	5866	98020	1.06	75.7	21.2	0.25	2.15	0.73	193154
RF-05	12/12/13	6.82	0	4.25	52820	52050	28	2350	3.9	404300	1467	5940	99620	1.07	153.9	47.1	0.37	2.25	0.67	177824
RF-06	12/12/13	6.4	0	4.34	70040	36810	7.2	2683	0	344800	1983	5430	79150	1.15	41	16.2	0.15	1.81	0.51	170708
RF-07	12/12/13	8.49	0	2.71	37050	60320	60.8	2189	7.2	441600	1080	5858	108500	1.04	312.7	113.3	0.71	2.57	1.03	195156
RF-08	12/12/13	6	0	4.57	68710	36860	6.3	2649	0	349900	1941	5531	80830	1	29	18.6	0.19	1.64	0.43	213740
RF-09	12/12/13	6.39	0	4.98	78920	43290	8.1	2575	0	401800	1742	6309	94570	1.08	65.2	36.6	0.28	1.98	0.6	135987
LCKY-01	12/13/13	8.62	0	0	52500	9482	61.3	2455	24.1	68120	4738	2784	24730	0.92	190.7	45	0.22	0.7	0.74	62040
LCKY-02	12/13/13	6.32	0	0	18020	8815	15.8	2097	0	56630	4544	2247	21980	0.41	20.6	2.5	0.06	0.35	0	66980
LCKY-03	12/13/13	6.02	0	0	17650	8548	28.7	2075	4.7	58220	4870	2216	21140	0.39	53.6	6.4	0.09	0.37	0	59702
LCKY-04	12/13/13	5.57	0	0	17160	8744	11.3	2028	0	61470	5738	2302	21340	0.41	15.4	2.1	0.05	0.34	0	75544
LCKY-05	12/13/13	5.52	0	0	17430	8651	14.6	2054	4	57940	5117	2291	21340	0.61	28.6	3.5	0.05	0.38	0	80403
LCKY-06	12/13/13	6.21	0	0	17210	8962	32.2	1988	5.2	62080	5909	2385	21820	0.43	55.1	10.1	0.13	0.49	0.22	77937
YC-01	12/13/13	6.07	0	0	20710	8878	47.9	2769	8.3	58810	3068	2352	24420	0.62	46.3	4.6	0.09	0.55	0.35	87668
YC-02	12/13/13	6.25	0	0	21090	9135	58.6	2648	6.8	59640	2762	2376	24550	0.52	73.9	10.6	0.14	0.61	0.45	90053
YC-03	12/13/13	5.98	0	0	23110	8870	26.5	2618	4.2	58720	2077	2392	23580	0.69	21.2	1	0.06	0.46	0.2	101071
YC-04	12/13/13	6.63	0	0	26400	9565	65.8	2565	8.9	64340	1916	2571	26110	0.62	92	13.7	0.19	0.6	0.42	119073

YC-05	12/13/13	7.39	0	0	33540	10070	73.7	2461	8	68980	1575	2711	28590	0.75	111.8	18	0.26	0.76	0.45	158693
YC-06	12/13/13	7.29	0	2.35	52330	12380	104.7	2422	13	97700	1753	3197	37260	1.64	170.3	28	0.36	1.05	0.72	167226
YC-07	12/13/13	7.46	0	2.3	55980	12720	110	2394	12	104300	1877	3235	38440	1.03	181.8	34.5	0.4	1.08	0.63	86233
YC-08	12/13/13	7.55	0	0	15840	10380	60.3	2488	4.2	62890	607.9	2699	27520	0.56	88	10.1	0.22	0.74	0.36	119710
CC-01	1/16/14	7.07	0	1.62	33200	24000	19.1	2265	0	197600	2147	3653	49620	0.69	45.4	20.6	0.13	1.16	0.6	135560
CC-02	1/16/14	6.95	0	1.82	34150	24420	22	2240	0	198400	1954	3701	50640	0.6	54.6	23.1	0.21	1.3	0.71	155323
CC-03	1/16/14	6.89	0	2.45	38620	26700	12.1	2179	0	226800	1892	3988	55010	0.58	32.1	13.8	0.12	1.33	0.58	152838
CC-04	1/16/14	8.55	0	1.83	41480	25980	14.7	2171	0	221400	1870	4060	54580	0.6	36.4	14.9	0.14	1.46	0.62	168788
CC-05	1/16/14	6.12	0	1.41	43950	21250	13.7	2310	0	192200	2216	3157	44990	0.65	21.6	18.4	0.14	1.01	0.43	158236
CC-06	1/16/14	6.07	0	1.67	44110	21620	13.7	2293	0	188700	2118	3167	45150	0.54	17.6	18.7	0.12	0.99	0.42	156296
CC-07	1/16/14	5.82	0	0	37090	14700	19.6	2320	0	143100	2237	2526	34080	0.49	27.6	29.4	0.16	0.87	0.37	128200
CC-08	1/16/14	6.5	0	0	15150	10330	12.7	2653	0	83500	1478	1756	21440	0.28	14.2	5.6	0	0.54	0.32	193390
CC-09	1/16/14	6.01	0	0	79130	16310	15.4	2300	0	208900	2473	3125	37890	0.64	25.1	27.2	0.2	0.97	0.52	122658
CC-10	1/16/14	6.14	0	0	27410	15460	25.5	2278	0	136300	1674	2446	35730	0.42	43.7	37.6	0.19	1.06	0.36	100798
CC-11	1/16/14	7.13	0	4.59	298300	21210	11.4	2215	0	558900	5222	6193	45830	1.74	0	1.1	0.1	0.89	0.43	107913
CC-12	1/16/14	6.25	0	1.33	42010	21510	11.8	2313	0	192200	2144	3171	44520	0.98	18.8	15.7	0.11	1.01	0.46	105374
CC-13	1/16/14	7.06	0	1.52	34780	31580	12.3	2010	0	262400	1195	4856	66270	0.67	33.6	11.1	0.13	1.84	0.56	106637
CC-14	1/16/14	7.05	0	2.02	36380	32950	6.7	2009	0	275800	1129	5095	70140	0.62	0	8.2	0.11	1.94	0.53	110255
CC-15	1/16/14	7.02	0	2.72	38320	33770	6.6	1984	0	299000	941	5230	71820	0.49	0	8.9	0.11	1.94	0.56	87420
LCVA-01	1/16/14	6.54	0	0	53770	24790	15.1	2439	0	184300	6447	3242	49560	0.89	51.7	45.5	0.09	0.73	0.4	48582
LCVA-02	1/16/14	6.84	0	0	54000	25130	27.9	2453	0	182500	6430	3226	49730	0.91	95.2	71.9	0.14	0.79	0.49	142430
LCVA-03	1/16/14	7.35	0	0	53820	24860	24.1	2386	0	182200	6351	3239	49380	0.82	82.8	75	0.13	0.92	0.52	94872
LCVA-04	1/16/14	5.91	0	0	56020	26610	7.6	2432	0	189200	6382	3399	52020	0.94	20.6	37.5	0.08	0.76	0.33	436677
LCVA-05	1/16/14	6.54	0	0	59740	23420	10.4	2458	0	171400	6259	3274	48560	0.88	20.1	59.2	0.06	0.82	0.41	113731
LCVA-06	1/16/14	6.26	0	0	56620	19960	10.5	2371	0	152300	7564	2947	42180	0.97	26.8	75.9	0.07	0.62	0.34	130893
LCVA-07	1/16/14	5.6	0	0	102900	24700	0.1	2948	8.6	189200	3606	3898	54870	1.53	35.9	181.2	0.06	0.56	0.37	124596
LCVA-08	1/16/14	6.91	0	0	28160	17890	44.3	2161	0	136200	9037	2531	35090	0.6	121.3	50.2	0.2	0.78	0.51	144288
RF-01	1/16/14	6.33	0	2.13	48940	40670	12.4	2094	0	310400	1574	4487	73840	0.76	65.1	39.2	0.21	1.43	0.54	178997
RF-02	1/16/14	14.57	0	3.04	51060	42950	8.7	2170	0	321000	1614	4713	77780	1.1	55	42.1	0.21	1.57	12.47	180242
RF-03	1/16/14	8.84	0	2.7	48770	45320	43	2181	0	338000	1517	4913	83490	0.84	270.7	79.5	0.43	1.86	0.88	176744
RF-04	1/16/14	7.77	0	3.11	51570	45280	23.7	2121	0	363100	1570	4963	85500	0.89	131.2	51.5	0.32	1.85	0.65	180469
RF-05	1/16/14	6.7	0	3.2	51850	44980	9	2090	0	365200	1432	4985	85030	0.89	43.3	39.7	0.36	1.99	0.74	189675
RF-06	1/16/14	7.23	0	3.13	61850	30820	5.9	2341	0	267400	1604	4383	62610	0.92	33.5	30.6	0.13	1.74	0.5	174176
RF-07	1/16/14	6.77	0	1.66	42270	56170	35.9	1968	0	436200	1168	5148	100800	0.96	167.9	62.5	0.44	1.92	0.84	193895

RF-08	1/16/14	6.46	0	1.85	56900	29270	9.1	2282	0	277300	1773	4321	62640	0.7	53.4	42.2	0.18	1.09	0.43	94754
RF-09	1/16/14	7.11	0	2.4	67440	35380	28.8	2242	0	342200	1576	4935	75540	0.87	164.3	62.8	0.29	1.56	0.59	159767
LCKY-01	1/17/14	6.89	0	0	59410	8903	15.5	2086	0	66560	5245	2498	21610	0.75	60.6	27	0.06	0.4	0.41	53494
LCKY-02	1/17/14	5.61	0	0	15790	7405	8.6	1816	0	46780	5590	1792	17620	0.26	0	0.9	0	0.27	0.15	59542
LCKY-03	1/17/14	5.77	0	0	15100	6981	7.3	1772	0	46300	5919	1742	16330	0.22	0	1	0	0.25	0.11	55906
LCKY-04	1/17/14	8.08	0	0	14550	7082	7.1	1733	0	46740	6873	1790	16500	0.2	0	0.9	0	0.29	0.13	64518
LCKY-05	1/17/14	5.39	0	0	14520	7084	8.3	1729	0	46210	6606	1798	16570	0.23	0	0.8	0	0.27	0.1	49949
LCKY-06	1/17/14	6.52	0	0	14600	7351	25.6	1692	0	46400	7044	1861	17300	0.25	40.2	10.1	0.08	0.35	0.25	90671
YC-01	1/17/14	5.68	0	0	21920	7418	23.2	2246	0	51180	2432	1980	17570	0.19	20.6	1.8	0	0.37	0.34	92391
YC-02	1/17/14	5.63	0	0	22840	7773	21.9	2204	0	52590	2223	2025	18410	0.19	12.7	1.1	0	0.34	0.31	83999
YC-03	1/17/14	5.6	0	0	25170	7733	34.4	2192	0	51040	1676	2042	18510	0.3	21.5	1.3	0	0.3	0.32	110759
YC-04	1/17/14	6.37	0	0	31400	8898	37.9	2160	0	58560	1736	2333	21370	0.43	24.1	1.8	0	0.39	0.29	135972
YC-05	1/17/14	5.61	0	0	36690	8974	23.1	2084	0	62730	1698	2386	21680	0.38	11.2	1.1	0	0.34	0.21	170496
YC-06	1/17/14	5.56	0	0	57200	10530	34.5	2046	0	87510	1477	2696	27990	0.57	30.5	3.6	0.07	0.47	0.35	173896
YC-07	1/17/14	5.39	0	0	58270	10650	37.9	2053	0	88850	1470	2695	27940	0.4	34.6	4.4	0.08	0.44	0.34	110059
YC-08	1/17/14	6.36	0	0	21430	11260	36.1	2189	0	67470	563	2806	27190	0.36	35	3.5	0.1	0.53	0.3	103902
CC-01	2/21/14	24.89	0.75	0	17150	16740	1087	2456	53.8	125000	2497	2950	42730	1.13	2536	187	2.81	4.1	5.58	107913
CC-02	2/21/14	21.8	0.62	0	16780	16240	962.9	2337	54.2	122900	2172	2910	40760	1.02	2163	156.7	2.43	3.68	5.21	107897
CC-03	2/21/14	23.59	0.32	0	19640	17760	526.2	2062	22.1	140900	2193	3080	45110	0.61	1171	112.7	1.5	2.88	3.07	114079
CC-04	2/21/14	21.09	0.32	0	19800	16900	519.6	2079	23.8	136300	2268	3224	43420	0.61	1166	108.8	1.42	2.8	3.35	108061
CC-05	2/21/14	23.32	0.92	0	19840	11070	677.2	2132	28.7	88590	2726	2091	33480	0.67	1570	163.5	1.76	2.54	3.41	100765
CC-06	2/21/14	25.53	0.37	0	19860	11190	792.7	2211	32.3	88930	2702	2101	35520	0.75	1676	147	2	2.69	3.89	134398
CC-07	2/21/14	25	0.38	0	16920	9154	792	2170	34.1	72080	2693	1889	32000	0.81	1668	165.9	2.11	2.8	3.65	82289
CC-08	2/21/14	19.31	0.21	0	13840	8467	486.7	2149	17.2	66180	2354	1727	24690	0.46	1014	98	1.3	1.79	2.28	95745
CC-09	2/21/14	20.18	0.24	0	15080	9072	544	2078	23.4	71670	2748	2113	28450	0.58	1135	110.9	1.42	2.19	3.88	109392
CC-10	2/21/14	22.7	0.26	0	14600	8956	558.8	2043	20.7	70700	2500	1824	27540	0.56	1145	110.1	1.43	2.13	2.48	87506
CC-11	2/21/14	15.62	0	1.94	186900	12950	553.4	2003	7	311100	4203	4595	31760	0.42	643.3	32.9	0.81	1.34	1.82	97133
CC-12	2/21/14	32.57	0.41	0	20040	11210	553.6	2114	21.3	90560	2721	2125	32070	0.59	1160	100.3	1.36	2.11	2.72	91092
CC-13	2/21/14	16.19	0	1.2	18080	21900	294.1	1968	12.1	176000	1244	3771	49930	0.41	662.4	56.5	0.8	2.45	1.87	78912
CC-14	2/21/14	17.05	0	1.38	19420	23220	316.7	1918	14.1	187700	1059	4029	51670	0.41	715.7	57.3	0.88	2.67	1.88	85027
CC-15	2/21/14	19.23	0	1.4	20560	24520	296.7	1828	10.7	200300	577.5	4292	53850	0.4	647.6	51.8	0.81	2.65	1.68	66786
LCVA-01	2/21/14	16.97	0.38	0	30200	17640	693.4	2437	31.5	122000	12310	2437	34620	0.76	1488	172.6	1.53	2.36	3.29	59494
LCVA-02	2/21/14	18.93	0.29	0	30590	17700	673	2443	28.7	122100	12410	2441	35270	0.75	1457	181.4	1.54	2.25	3.27	73952
LCVA-03	2/21/14	15.89	0.3	0	30850	17530	594.4	2411	26.6	121300	12710	2405	34060	0.64	1284	151.9	1.34	2.07	2.89	63763

LCVA-04	2/21/14	16.62	0.3	0	31560	18480	569.3	2331	24.8	128200	12550	2497	36180	0.64	1208	140.2	1.3	2.04	2.75	302535
LCVA-05	2/21/14	15.57	0.22	0	32770	14900	542.3	2360	22.4	107100	12640	2253	31080	0.6	1112	126.4	1.24	1.94	2.59	88474
LCVA-06	2/21/14	14.5	0.26	0	30030	12580	578.2	2292	22.4	89860	14650	2016	26370	0.63	1193	124.6	1.71	1.95	2.65	82554
LCVA-07	2/21/14	6.23	0	0	98870	25920	0.4	2847	8.7	213900	3515	3862	58500	0	43.9	180.3	0.07	0.52	0.18	94684
LCVA-08	2/21/14	19.06	0.28	0	20870	10640	585.9	2160	26.6	73140	14780	1774	21880	0.65	1211	96.7	1.34	1.94	2.81	106785
RF-01	2/21/14	16.11	0.55	1.12	32010	28880	430.2	2313	22.8	218900	2028	3518	55450	0.48	1370	161.3	1.62	2.74	2.38	102520
RF-02	2/21/14	21.91	0.48	1.37	33790	30680	387.6	2312	17.6	235200	2060	3718	58610	0.71	1199	146.5	1.76	3	2.42	107913
RF-03	2/21/14	16.11	0.32	1.38	32030	31230	320.7	2203	11.6	243400	1965	3735	59610	0.37	930.7	120.6	1.22	2.58	1.92	104318
RF-04	2/21/14	25.5	0.28	1.32	35240	31020	346.2	2225	12.5	253700	2211	3812	61850	0.38	945.5	117.7	1.26	2.64	1.83	108106
RF-05	2/21/14	23.49	0.3	1.54	35670	31440	360.7	2195	11.7	256800	2167	3826	62770	0.35	901.9	105.1	1.19	2.45	1.77	105891
RF-06	2/21/14	24.89	0.23	1.55	34370	18110	424.8	2229	10.7	156300	2883	3102	39710	0.28	842	88.8	0.73	1.75	1.67	85254
RF-07	2/21/14	1.63	12.17	0	30880	38060	81	1847	42.1	268000	1300	3855	71060	0.17	0	367.5	46.05	0.39	1.86	332884
RF-08	2/21/14	17.3	0.25	0.86	27390	15470	618.3	2172	9	134600	3134	2797	35790	0.31	853.7	82.8	0.69	1.39	1.3	58273
RF-09	2/21/14	13.96	0	1.02	31190	18490	597.2	2066	7.4	164800	3710	3140	42240	0.26	658.4	79.1	0.63	1.35	1.1	87044
LCKY-01	2/22/14	7.15	0	0	30000	5939	54	2003	6.6	41940	6642	1744	14690	0.06	106.4	16.4	0.11	0.29	0.36	36211
LCKY-02	2/22/14	6.87	0	0	10620	4948	50.8	1792	0	29470	7627	1351	11760	0.08	81.6	8.1	0.11	0.32	0.25	34049
LCKY-03	2/22/14	6.7	0	0	10500	4824	54	1755	0	28940	7886	1346	11430	0.06	85	8.2	0.13	0.28	0.24	35214
LCKY-04	2/22/14	7.03	0	0	10780	4930	78.6	1766	0	29990	9104	1383	11390	0.09	135.1	12.7	0.19	0.42	0.33	32779
LCKY-05	2/22/14	6.49	0	0	10620	4887	64.2	1747	0	29680	8703	1374	11530	0.1	108.5	9.3	0.15	0.33	0.25	36508
LCKY-06	2/22/14	6.32	0	0	10910	4937	42.4	1687	0	30140	9855	1411	11610	0	66.1	5.8	0.1	0.24	0.17	47212
YC-01	2/22/14	7.28	0	0	11480	4764	106	2329	0	29120	2537	1376	11220	0.13	171.9	11.5	0.2	0.44	0.6	43733
YC-02	2/22/14	7.26	0	0	11880	4936	121.7	2296	0	29360	2316	1390	11660	0.13	195	13.6	0.23	0.43	0.64	51132
YC-03	2/22/14	6.98	0.37	0	13050	5189	106.3	2563	4.3	30710	2048	1469	11980	0.11	177.7	12.3	0.21	0.43	0.39	59678
YC-04	2/22/14	7.13	0.35	0	16660	5944	138	2513	4.7	36920	2067	1662	14210	0.12	321.2	19.9	0.32	0.51	0.48	77849
YC-05	2/22/14	6.62	0.26	0	21810	6148	116.3	2449	6.4	39050	1859	1745	15210	0.11	207.7	14.7	0.25	0.51	0.42	120331
YC-06	2/22/14	7.08	0.22	0	36620	7752	156.9	2338	6.9	59090	1324	2130	21100	0.19	294.6	21.2	0.3	0.62	0.52	115307
YC-07	2/22/14	7.27	0.22	0	37120	7884	177.8	2386	7.5	59600	1289	2148	21080	0.18	311.1	21.1	0.35	0.65	0.59	65484
YC-08	2/22/14	8.08	0	0	11550	7584	129.2	2477	0	44120	519.9	2082	18890	0.14	241.2	12.6	0.3	0.76	0.42	238125
CC-01	3/28/14	10.44	0	3.05	46010	27120	39.3	1982	0	209000	4510	4263	58190	0.78	136.2	33	0.19	1.01	0.74	193077
CC-02	3/28/14	7.17	0	3.01	45770	27460	28.4	2014	0	214900	3445	4304	58610	0.78	96.2	26.1	0.15	0.99	0.62	198463
CC-03	3/28/14	7.59	0	3.53	50510	29670	29.8	1962	0	234500	3441	4642	63020	0.77	101.2	28.7	0.17	1.06	0.73	187736
CC-04	3/28/14	6.96	0	3.07	54390	27540	25.7	1932	0	230300	3549	4581	60550	0.82	72.1	15.5	0.11	1.1	0.65	183008
CC-05	3/28/14	7.1	0	3.68	54760	26070	30.3	2005	0	203100	4065	3990	54980	0.87	101.9	26.5	0.14	0.78	0.52	196506
CC-06	3/28/14	7.07	0	3.61	55040	26360	21.8	1977	0	203800	3948	4042	55010	0.85	67.8	18	0.11	0.79	0.5	179475

CC-07	3/28/14	7.6	0	1.32	41480	15320	25.7	1820	0	123600	4803	2920	39520	0.65	109.1	33.3	0.12	0.53	0.4	153743
CC-08	3/28/14	13.45	0	1.3	45960	16100	49.2	1949	0	137100	4525	2975	41620	0.72	153	45.6	0.16	0.58	0.43	165988
CC-09	3/28/14	6.87	0	1.39	42840	16230	45.6	2126	0	136600	4676	2951	42220	0.7	192.5	53.6	0.18	0.65	0.49	141532
CC-10	3/28/14	7.61	0	1.13	23490	16560	55.6	2076	0	118800	4238	2716	43450	0.61	244.1	57.9	0.19	0.59	0.42	146282
CC-11	3/28/14	6.79	0	3.08	292000	16810	2.7	2479	0	377300	7302	5814	31870	2.41	0	1	0.08	0.5	0.32	147460
CC-12	3/28/14	11.15	0	3.99	51800	26730	25.9	2050	0	211900	4105	3943	55230	0.83	89.6	22.9	0.14	0.77	0.56	152048
CC-13	3/28/14	8.93	0	3.36	46940	31760	59.4	1981	0	259900	1633	5299	72430	0.84	142.4	26.1	0.19	1.67	0.67	146942
CC-14	3/28/14	10.94	0	3.25	48030	32230	72.3	2008	0	265500	1316	5395	74550	0.85	194.4	33	0.26	1.81	0.82	163852
CC-15	3/28/14	10.25	0	2.86	51200	33970	74.5	2054	0	277100	950.2	5661	77260	0.88	240.2	53.8	0.34	2.45	1.31	112163
LCVA-01	3/28/14	15.94	0	1.16	67830	31490	115.8	2663	14.6	216000	6483	3967	64570	1.17	604.8	315.7	0.48	1.17	1.33	122260
LCVA-02	3/28/14	13.2	0.22	1.16	67720	31420	128	2667	16.6	218100	6826	3925	64340	1.22	687.3	386.8	0.5	1.28	1.63	122893
LCVA-03	3/28/14	13.29	0.21	0	70600	31980	131.8	2688	18.4	217100	7220	4045	65340	1.25	707.2	419.2	0.5	1.25	1.46	109244
LCVA-04	3/28/14	11.18	0.21	1.1	69330	34570	102.7	2611	15.9	240100	7913	4131	67630	1.21	580.1	355	0.4	1.19	1.24	515165
LCVA-05	3/28/14	8.67	0	0.84	71760	26790	69.5	2709	14.1	195500	6005	3712	58080	1.18	432.4	287.1	0.29	0.94	0.97	146348
LCVA-06	3/28/14	6.33	0	0	79030	24360	31	2713	8.4	177700	5756	3689	54450	1.25	187.4	151.2	0.13	0.43	0.31	154804
LCVA-07	3/28/14	6.11	0	0	96780	26250	1.3	3111	5.1	196000	3010	4035	59410	1.54	55.9	188.4	0.05	0.33	0	150004
LCVA-08	3/28/14	12.93	0.28	1.45	39250	20680	148.5	2250	8	150200	9540	2966	43210	0.69	627.9	180.5	0.59	1.18	1.25	157588
RF-01	3/28/14	8.07	0	3.04	68030	47150	12.3	2339	0	353600	1877	5341	84180	0.97	121.1	42	0.19	1.16	0.43	210920
RF-02	3/28/14	7.96	0	2.66	67850	47000	9.7	2326	0	354300	1780	5354	84710	0.99	124.4	52.2	0.19	1.18	0.39	228131
RF-03	3/28/14	10.23	0	3.43	59780	48040	10.9	2238	0	363400	1576	5283	87170	0.95	119.4	50.4	0.21	1.27	0.4	221835
RF-04	3/28/14	8.62	0	3.1	63590	47750	10.2	2275	0	376300	1784	5348	90190	0.94	129.6	42.1	0.21	1.39	0.41	229981
RF-05	3/28/14	8.41	0	3.07	66460	48320	12.3	2278	0	371400	1506	5543	91670	0.95	109.7	51.6	0.24	1.46	0.39	240315
RF-06	3/28/14	10.41	0	3.51	68720	32250	6.8	2441	0	254900	1855	4700	64010	0.99	64.6	29.9	0.12	1.52	0.32	264568
RF-07	3/28/14	10.14	0	2.03	62650	57900	29	2116	0	474300	982.8	5636	108600	0.95	210.9	81	0.41	1.41	0.53	309341
RF-08	3/28/14	9.2	0	2.47	62920	29720	10.8	2398	0	277200	2437	4457	64700	0.78	87.1	47.3	0.16	0.74	0.28	119909
RF-09	3/28/14	7.57	0	3.04	72890	37080	13.9	2308	16.6	350600	2339	5224	79590	0.83	111.3	74.5	0.18	0.73	0.3	230576
LCKY-01	3/29/14	11.13	0	1	92280	9443	27.3	2305	19.5	75600	7085	3152	25470	1.24	228	52.8	0.1	0.35	0.51	68748
LCKY-02	3/29/14	6.77	0	0.88	21120	7968	36.1	1556	6.7	46510	6394	2128	20580	0.42	47.3	58.9	0.24	0.23	0.14	65163
LCKY-03	3/29/14	6.79	0	0	20190	7697	43.8	1510	0	45060	7732	2012	19140	0.37	61.6	7.5	0.1	0.23	0.1	55599
LCKY-04	3/29/14	6.74	0	0.89	18340	7569	30.5	1519	0	45750	9567	1991	18670	0.32	39.4	4.6	0.07	0.23	0	58128
LCKY-05	3/29/14	6.82	0	0.88	18210	7439	33	1557	0	44530	9062	1955	18200	0.29	50.7	6	0.08	0.23	0	50835
LCKY-06	3/29/14	8.53	0	1.11	17990	7571	32.8	1418	0	44660	9894	2026	18510	0.31	39.4	4.3	0.07	0.25	0	117215
YC-01	3/29/14	8.52	0	1.05	40320	8526	48.6	2029	0	53220	3210	2767	22260	0.64	40.3	5	0.07	0.3	0.25	127744
YC-02	3/29/14	8.19	0	0.98	41750	8692	50.5	2047	0	53970	3448	2735	22760	0.71	44.9	4.6	0.08	0.29	0.28	126503

YC-03	3/29/14	9.08	0	0	45130	8811	61.2	2073	0	51210	2245	2769	22850	0.73	45.7	4.9	0.07	0.26	0.19	153136
YC-04	3/29/14	8.33	0	0.85	53280	9682	125.5	2258	0	58400	2681	3089	25110	0.94	86.2	5.5	0.11	0.32	0.34	164910
YC-05	3/29/14	8.42	0	0	56140	9239	93.2	2218	0	64860	3088	2898	23980	0.31	67.7	33.3	0.2	0.28	0.25	224406
YC-06	3/29/14	16.05	0	0	81350	9954	207.7	2062	0	80950	2175	2938	27120	0.37	203.1	35.4	0.48	0.49	0.89	220176
YC-07	3/29/14	25.14	0.3	0	78220	9621	551.3	2109	5.8	75640	1945	2824	25590	0.45	463.3	85.4	1.19	0.91	2.1	122054
YC-08	3/29/14	32.78	0	0	23330	11840	77.1	2198	0	68770	619.7	3113	29510	0.22	341.7	13.8	0.29	0.66	0.69	187410
CC-01	4/18/14	0.37	0	2.5	41460	26960	7.6	2362	0	203300	3058	4376	58190	0.45	19	0.9	0.07	0.66	0.96	202519
CC-02	4/18/14	0.47	0	2.77	41390	26710	8.8	2311	0	206200	2758	4370	57140	0.45	19.4	1.3	0.07	0.9	5.34	180964
CC-03	4/18/14	0.28	0	3.22	46760	29290	5.2	2294	0	228700	2620	4686	62400	0.52	9.7	0.6	0.07	0.81	0.7	199256
CC-04	4/18/14	0	0	2.72	50240	27860	6.4	2316	0	219200	2512	4757	61110	0.5	9.1	0.6	0.06	0.72	0.76	188250
CC-05	4/18/14	0	0	2.91	49430	24030	6.8	2440	0	174800	3593	3923	52100	0.53	9.4	0.2	0.06	0.54	0.54	182146
CC-06	4/18/14	0.44	0	2.89	46860	22690	18.3	2389	0	181400	3621	3672	49340	0.45	38.1	9.6	0.1	0.73	0.57	167173
CC-07	4/18/14	0	0	1.1	35920	14860	13.8	2391	0	114700	4080	2873	38460	0.42	26.3	0.8	0.06	1.94	0.67	149519
CC-08	4/18/14	0	0	1.1	36650	15360	16.9	2591	0	120400	4158	2936	39570	0.45	21.2	0.7	0.05	0.35	0.45	159165
CC-09	4/18/14	0	0	2.33	110500	16620	12.6	2428	0	194100	4804	3873	38870	0.66	23.8	1.7	0.07	0.37	0.48	128057
CC-10	4/18/14	0.63	0	0.95	21270	15710	35.7	2494	0	107900	3468	2750	41520	0.44	114.3	25.2	0.15	0.46	0.45	121336
CC-11	4/18/14	0.28	0	3.01	309300	19530	2.5	2522	0	420700	7959	6433	34970	1.38	0	0.4	0.09	0.42	0.67	149119
CC-12	4/18/14	0	0	2.91	48540	25400	8.6	2494	0	183100	3474	4007	53400	0.49	14.5	0.9	0.06	0.53	0.49	129699
CC-13	4/18/14	0.86	0	2.66	47800	24990	28.8	2477	0	180800	3512	3953	53140	0.51	71	16.4	0.13	0.55	0.63	145363
CC-14	4/18/14	0.23	0	2.93	47110	35230	6.1	2142	0	269400	1257	5852	76540	0.55	7.3	0.4	0.07	1.11	0.54	133485
CC-15	4/18/14	1.63	0	3.44	50200	36910	29.2	2206	0	286500	922.2	6160	81180	0.55	77.9	14.1	0.16	1.75	0.75	111472
LCVA-01	4/18/14	2.25	0	0	62970	30250	89.9	2521	11.7	202200	8386	3876	61480	0.69	393.1	173.3	0.35	0.82	1.08	109483
LCVA-02	4/18/14	4.97	0	0	64180	30840	75.7	2531	6.1	205900	8567	3943	62410	0.72	308.9	142.7	0.31	0.71	0.99	216074
LCVA-03	4/18/14	2.56	0	0	63940	30630	76.1	2529	11	208600	8642	3922	61830	0.72	316.7	156.1	0.32	0.82	0.84	96107
LCVA-04	4/18/14	3.65	0	0.97	63200	32940	113.5	2742	13.7	223400	8222	4049	64640	0.78	478.3	250.3	0.47	0.97	1.14	502816
LCVA-05	4/18/14	2.91	0	0	67060	26720	61.5	2807	12.8	186900	8148	3755	56970	0.73	235.9	141.3	0.25	0.69	0.68	130294
LCVA-06	4/18/14	1.11	0	0	73000	24450	69.5	2808	10.6	174700	8833	3660	53150	0.78	259.9	172.4	0.24	0.44	0.63	142960
LCVA-07	4/18/14	0	0	0	106700	29820	0.3	3358	8.3	220200	3479	4482	66350	0.95	13.6	196.7	0.09	0.35	0.28	139097
LCVA-08	4/18/14	0.28	0	0	35320	18780	18.5	2344	0	115400	11400	2961	39860	0.44	60	18	0.11	0.32	0.45	157959
RF-01	4/18/14	0.78	0	2.75	65100	45420	22.9	2185	5.1	328200	1970	5185	83240	0.5	148.8	56.3	0.27	0.99	0.85	176573
RF-02	4/18/14	0.99	0	2.99	65480	45600	16.9	2253	0	334500	1956	5208	83260	0.56	123.5	56.9	0.25	1.01	0.87	198736
RF-03	4/18/14	1.03	0	2.63	59890	47660	19.7	2391	0	349200	1762	5352	88350	0.56	148.5	64.3	0.28	1.11	0.8	186753
RF-04	4/18/14	0.79	0	3.27	63930	48860	19.3	2286	0	374600	1879	5516	92990	0.56	136.2	51.7	0.29	1.23	0.81	205572
RF-05	4/18/14	0.92	0	3.07	65380	49370	17.6	2315	0	377200	1770	5598	94210	0.58	98.2	52.5	0.26	1.25	0.83	195491

RF-06	4/18/14	1.8	0	3.11	68420	32340	12.6	2539	0	254500	2189	4797	65070	0.58	75.9	31.7	0.14	1.49	6.21	219879
RF-07	4/18/14	1.53	0	1.84	61130	60310	53.9	2173	3.8	469200	1071	5792	111600	0.63	328.5	114.8	0.59	1.28	1.1	306952
RF-08	4/18/14	0.85	0	1.71	61320	29180	21.2	2501	0	243300	2528	4592	63500	0.49	110.9	53	0.23	1.07	0.58	115447
RF-09	4/18/14	1.04	0	2.63	69640	35880	37.4	2404	0	323000	2391	5200	77290	0.54	160.1	92.7	0.29	0.92	0.73	207606
LCKY-01	4/19/14	1.32	0	0	81530	9618	26.9	2451	28.2	78610	7294	3100	25090	0.52	136	29.2	0.1	0.18	0.62	67713
LCKY-02	4/19/14	1.98	0	0	20760	8537	14.5	1798	0	48420	7485	2324	22360	0.28	23	2.4	0.06	0.13	0.25	68711
LCKY-03	4/19/14	2.49	0	0	19930	8070	88.9	1804	3.8	45400	8826	2199	20850	0.34	163.5	18.7	0.26	0.38	0.57	49545
LCKY-04	4/19/14	1.03	0	0	18470	8010	105	1774	4.1	44700	10230	2219	20260	0.34	191	19.5	0.28	0.35	0.54	58137
LCKY-05	4/19/14	0.93	0	0	18030	7876	51.5	1747	0	46260	10830	2169	19650	0.28	91.2	11.8	0.17	0.19	0.29	55805
LCKY-06	4/19/14	1.11	0	0	18410	8106	92.2	1697	3.4	44580	10860	2278	20510	0.31	166.2	21.8	0.26	0.4	0.48	91300
YC-01	4/19/14	0	0	0.86	31730	8309	10.6	2082	5.3	50380	3067	2565	21410	0.39	8.4	0.5	0	0.14	0.34	108195
YC-02	4/19/14	0	0	0	33840	8764	17.3	2181	0	51490	2846	2608	22530	0.39	12.7	0.6	0	0.11	0.31	110903
YC-03	4/19/14	0.5	0	0.99	36070	8514	22	2206	0	53730	2134	2527	21700	0.38	14.3	0.6	0.05	0.28	0.27	142625
YC-04	4/19/14	1.19	0	0	45420	9923	21	2156	0	58290	2136	2945	25860	0.47	12.6	0.5	0.05	0.14	0.28	158986
YC-05	4/19/14	0	0	0	54320	10510	18.9	2174	0	58900	2067	3168	27570	0.54	11.6	0.4	0.05	0.14	0.23	228007
YC-06	4/19/14	0	0	1.17	77050	11240	59.3	2113	0	83900	1723	3246	30860	0.68	72.3	9.6	0.13	0.27	0.41	200171
YC-07	4/19/14	0	0	1.05	79780	11490	32.4	2064	0	82600	1609	3337	31950	12.66	96.7	1.6	0.06	0.3	0.8	122403
YC-08	4/19/14	0	0	0	26790	14110	11.3	2370	0	67220	609.5	3758	35080	0.45	0	0.1	0.06	0.26	0.17	173363
CC-01	5/15/14	20.54	0	0	29730	21270	666.2	2550	45.3	158800	2326	4153	56320	0.86	1426	190.2	1.98	3.45	6.63	186290
CC-02	5/15/14	17.39	0	0	29030	20710	598.6	2595	39.4	155700	1942	4091	54660	0.83	1299	165.4	1.79	3.55	4.75	169321
CC-03	5/15/14	30.64	0	1.44	35010	22360	389.9	2604	28.4	178300	1989	4199	59430	0.65	975.1	137.3	1.25	3.04	3.78	180133
CC-04	5/15/14	16.61	0	1.4	36870	23210	343.5	2529	23	188100	1939	4358	60780	0.63	825.5	120.5	1.11	2.89	3.05	180408
CC-05	5/15/14	17.82	0	1.08	38300	18760	219.3	2569	19.6	144400	3206	3529	50510	0.5	567.8	68	0.62	1.5	2.06	175837
CC-06	5/15/14	12.2	0	1.18	37760	18580	227.8	2544	14.4	143100	2904	3497	51040	0.45	587.1	76.4	0.67	1.53	2.08	165849
CC-07	5/15/14	11.58	0	0	31410	13720	206.8	2418	22.8	106600	3321	3028	44910	0.48	581.6	72.8	0.6	1.57	1.88	145043
CC-08	5/15/14	12.07	0	0	29140	12930	204.3	2650	20	98530	3026	2882	41260	0.48	581.5	74.8	0.64	1.19	2.13	144979
CC-09	5/15/14	14.88	0	1.36	251400	16010	173.4	2715	27	349000	7336	5455	48540	0.79	387.7	26.6	0.36	1.38	1.69	128366
CC-10	5/15/14	18.63	0	0	19250	16320	659.7	3013	53.1	94300	2710	3029	124400	1.6	1749	147.5	1.46	2.9	4	124833
CC-11	5/15/14	0.43	0	2.07	329600	17620	19.2	2681	0	420200	8617	6455	36740	1.44	22.5	3.1	0.12	0.6	0.68	129681
CC-12	5/15/14	15.9	0	1.38	39510	19640	242.9	2830	17.5	150600	3656	3650	52660	0.64	558.3	66.1	0.58	1.7	2.11	136953
CC-13	5/15/14	14.42	0	1.91	33340	30070	237.2	2505	14.8	241700	1167	5277	69030	0.51	506.1	71.2	0.71	2.86	2.18	136866
CC-14	5/15/14	15.34	0	1.71	33320	30400	222.5	2433	12.7	244700	972.7	5339	68500	0.46	487.3	70.4	0.71	2.86	1.97	133232
CC-15	5/15/14	15.25	0	2.35	33600	31360	240.5	2596	13	253100	616.2	5504	70590	0.52	466.7	61.1	0.66	2.78	3.15	119781
LCVA-01	5/15/14	21.45	0	0	62380	30220	116.1	2931	20.6	231400	9678	3998	61230	0.35	507.6	207.3	0.45	1.14	1.75	102917

LCVA-02	5/15/14	13.93	0	0	62760	30660	106.3	2859	20.5	235000	9905	4038	61890	0.34	450.6	188.2	0.42	1	1.8	422104
LCVA-03	5/15/14	11.78	0	0	63460	31480	91.3	2810	18.4	243200	9913	4083	63280	0.31	406.8	185.8	0.38	1.14	1.8	173017
LCVA-04	5/15/14	10.51	0	1.07	63920	33370	77.2	2730	15.9	256900	9674	4172	65580	0.33	357.3	182.9	0.35	1.05	2.22	496118
LCVA-05	5/15/14	8.91	0	0	66620	29330	81.1	2833	15.6	230500	9372	3959	60410	0.36	317.6	170.3	0.33	0.99	1.54	128451
LCVA-06	5/15/14	1.38	0	0	66340	27810	103.3	2750	11.7	219800	10250	3864	57440	0.37	325	134.6	0.37	0.84	1.1	137635
LCVA-07	5/15/14	0.27	0	0	108400	30860	4.7	3415	13.9	218800	3728	4587	67550	0.94	48.5	199.1	0.07	0.31	0.43	129244
LCVA-08	5/15/14	10.14	0	1.04	45030	25870	249.3	2467	22.7	203500	11020	3555	51630	0.44	903.7	305.7	1.06	1.77	2.32	125854
RF-01	5/15/14	10.35	0	1.9	65050	42330	129.4	2559	7.5	346300	2412	5289	77060	0.42	483.2	99.1	0.53	1.59	1.44	162947
RF-02	5/15/14	8.32	0	1.69	62630	40710	149.2	2509	8.4	330200	2652	5254	74550	0.39	483.4	94.2	0.69	1.81	1.37	201368
RF-03	5/15/14	1.99	0	2.06	58470	42920	109	2408	0	348000	2023	5269	79120	0.42	342.3	74.3	0.44	1.49	1.1	197904
RF-04	5/15/14	1.84	0	2.35	63740	43700	100.1	2449	3.4	373200	2098	5443	83260	0.4	312	65.1	0.47	1.67	5.39	200416
RF-05	5/15/14	16.5	0	1.66	63520	44370	299.9	2666	22.1	363900	1922	5395	86930	0.66	879.1	101	1.03	2.68	2.35	208327
RF-06	5/15/14	11.52	0	1.64	58470	54150	126.9	2320	5.6	450500	1302	5507	98460	0.38	510.7	99.7	0.78	2.24	1.9	167659
RF-07	5/15/14	11.2	0	2.94	67440	30010	163.6	2830	0	267900	2398	4815	60740	0.41	348.9	52.8	0.33	1.45	1.29	461435
RF-08	5/15/14	13.73	0	1.75	62170	27650	100.3	2659	4.5	265500	2974	4815	59140	0.31	350.4	69.2	0.33	1.14	2.03	179500
RF-09	5/15/14	11.17	0	2.19	65880	31500	198.1	2662	5	310700	2576	5010	69390	0.47	515.4	106.8	0.48	1.4	1.26	153362
LCKY-01	5/16/14	14.06	0	0	59110	7755	106.5	2599	24.7	58330	8146	2546	20310	0.28	297.9	55.8	0.29	0.77	1.21	44401
LCKY-02	5/16/14	7.2	0	0	17310	6170	110.9	2352	6.7	38080	9732	1813	18390	0.23	186.6	19.9	0.3	0.51	1.02	54367
LCKY-03	5/16/14	10.23	0	0	17050	6018	139.7	2321	8.1	36790	10280	1785	17760	0.26	377.5	33.3	0.46	0.68	1.2	42321
LCKY-04	5/16/14	10.83	0	0	16220	5860	106	2252	8.1	36090	11640	1762	16870	0.21	186.2	20.9	0.32	0.51	0.99	44843
LCKY-05	5/16/14	6.68	0	0	15710	5700	111.9	2260	7.3	35150	10720	1716	16450	0.2	205.6	23.7	0.33	0.56	0.93	46054
LCKY-06	5/16/14	8.11	0	0	16240	5900	113.5	2233	8.3	35860	12520	1798	17170	0.21	193.6	22	0.34	0.56	0.97	107709
YC-01	5/16/14	10.2	0	0	36910	8162	130.4	2998	11.1	53700	3535	2671	24660	0.28	227	29.6	0.37	0.62	1.23	126606
YC-02	5/16/14	6.29	0	0	38050	8307	126.8	2862	12.6	52930	3331	2658	25090	0.29	226.3	30.3	0.35	0.51	1.17	118974
YC-03	5/16/14	9.77	0	0	40370	8111	160.7	2822	14.2	52030	2398	2620	24430	0.34	262.4	34.2	0.44	1.16	1.48	137385
YC-04	5/16/14	3.2	0	0	48220	9129	304	2894	18.4	54660	2271	2921	27580	0.7	481.7	52.6	0.68	0.96	1.57	178409
YC-05	5/16/14	11.15	0	0	51410	8671	201.1	2760	17.1	57500	2282	2860	26600	0.38	330.6	43.2	0.57	1.1	1.85	109504
YC-06	5/16/14	11.13	0	0	81690	10220	266.4	2746	27.5	77730	1905	3232	34070	0.51	459.1	71.6	0.8	1.97	1.71	208806
YC-07	5/16/14	7.75	0	0	82890	10390	286.9	2841	26.7	78760	1903	3264	34230	0.56	477.4	67.3	0.84	1.06	1.68	118516
YC-08	5/16/14	8.01	0	0	23270	10940	141.4	2800	8.7	63490	696	3012	30320	0.3	222.6	18.4	0.44	1.25	1.32	224508
CC-01	6/17/14	0.32	0	2.28	66350	31800	21.9	2372	4.4	239300	4028	5548	71140	0.81	62.4	5.5	0.05	0.88	0.92	280636
CC-02	6/17/14	0.69	0	2.07	68480	32640	29.9	2467	6	239600	3773	5691	72950	0.8	88.8	16.8	0.1	0.92	0.92	193858
CC-03	6/17/14	0.49	0	2.42	71660	33250	23.9	2490	5.1	262800	3832	5656	73500	0.78	61.8	9.7	0.07	0.97	0.78	236207
CC-04	6/17/14	0.89	0	2.91	77500	31610	24	2509	5.8	247100	3584	5868	72980	1.04	66.7	10.9	0.09	1.05	0.89	241407

CC-05	6/17/14	0.43	0	2.82	89180	29300	23.1	2817	4.8	226400	4363	5172	66370	0.86	48.3	3.3	0.06	0.8	0.75	223833
CC-06	6/17/14	0.5	0	2.87	83270	27320	15	2779	0	241700	4758	4722	61980	0.44	33.8	1.6	0.05	0.67	0.73	183599
CC-07	6/17/14	0.58	0	1.54	87570	19590	28.7	3047	9.4	183100	5719	4377	54380	0.72	77.2	7.2	0.07	0.59	0.77	204815
CC-08	6/17/14	0.65	0	1.49	91820	19790	21.6	3053	7.4	189600	5590	4404	54520	0.75	80.5	8.6	0.09	0.66	0.69	190932
CC-09	6/17/14	9.37	0	3.61	297300	19440	90.8	2412	142.6	422300	6545	7005	46680	1.65	283.9	50.6	0.31	1	2.24	200108
CC-10	6/17/14	0.93	0	1.24	28600	21440	44.9	3455	7.5	137500	4760	3772	60540	0.66	247.2	78.1	0.2	0.89	0.8	203366
CC-11	6/17/14	0.3	0	3.68	334300	19610	12.8	2257	0	505400	6499	7415	42850	1.82	15	2	0.08	0.75	0.88	208884
CC-12	6/17/14	1.06	0	3.3	87270	30880	33.3	2979	6.5	235900	4570	5255	68570	0.93	99.8	13.1	0.1	0.94	0.96	209752
CC-13	6/17/14	0.39	0	2.1	60320	36700	21.7	2354	4.5	283800	3437	6516	81820	0.72	36.4	3.8	0.07	1.43	0.82	215466
CC-14	6/17/14	0.71	0	2.1	62590	37520	31.1	2273	4.9	276000	3029	6795	84620	0.73	69.2	13.9	0.1	1.61	0.79	263998
CC-15	6/17/14	1.2	0	2.67	65060	38620	35.8	2302	3.7	312600	3439	6891	87050	0.79	57.4	15	0.09	2	0.75	191857
LCVA-01	6/17/14	0.49	0	0	88140	37560	18.2	2930	6.5	239200	6026	4809	78600	1.03	83.7	22.7	0.08	0.65	0.75	194942
LCVA-02	6/17/14	2.15	0	0	88920	37910	30.9	2964	7.8	240100	6018	4885	80180	1.09	135.3	43.7	0.12	0.73	0.95	466636
LCVA-03	6/17/14	0.88	0	0	88780	37910	27.8	2897	7.6	245500	6063	4821	80350	1.1	125.1	47.4	0.11	0.67	0.7	154610
LCVA-04	6/17/14	0.3	0	0	89200	36550	13.6	2801	4.4	246200	5969	4736	78430	1.1	57.1	20.3	0.06	0.62	0.55	520641
LCVA-05	6/17/14	0.28	0	0	91470	30960	4.8	3078	6.4	233000	5811	4308	71350	0.64	20.9	15.9	0	0.52	0.41	208015
LCVA-06	6/17/14	0	0	0	99420	29590	2.8	3069	13.6	200300	5187	4471	69450	1.21	39.3	161.1	0	0.4	0.22	190876
LCVA-07	6/17/14	0.38	0	0	108900	30480	0.3	3276	19.5	198400	3567	4697	71090	1.37	50	200.4	0	0.46	0.24	195750
LCVA-08	6/17/14	0.31	0	1.51	56520	30120	21.4	2718	5	202800	16170	4302	67320	0.72	61.2	13.5	0.07	0.65	0.61	202519
RF-01	6/17/14	1.36	0	2.56	84880	51850	53.5	2582	12.9	366000	2986	6408	96420	0.88	297.2	79.2	0.32	1.48	1.17	281456
RF-02	6/17/14	0.56	0	2.53	80910	49170	19.4	2527	8.4	387400	2559	5915	90440	0.46	124	32.2	0.15	1.23	0.92	324272
RF-03	6/17/14	0.46	0	2.74	77550	53840	18.7	2385	6	369700	1860	6498	101200	0.85	90.3	21.2	0.14	1.36	0.8	288619
RF-04	6/17/14	0.51	0	2.97	80760	53610	16.3	2423	4.9	391500	2038	6529	103400	0.83	96.8	15	0.13	1.41	0.81	288186
RF-05	6/17/14	0.42	0	2.86	79840	53720	12	2401	6.2	403600	1941	6426	104200	0.85	90.9	18.3	0.15	1.57	0.94	320091
RF-06	6/17/14	1.14	0	2.99	84590	32800	8.1	2734	4.6	266000	2622	5326	68430	0.85	72.6	14.8	0.05	1.41	0.65	326069
RF-07	6/17/14	7.39	0	1.79	74340	64220	22.5	2256	7.2	512900	1298	6505	117000	0.8	160.5	50.4	0.3	1.48	1.1	322368
RF-08	6/17/14	1.58	0	2.35	81510	29600	26.8	2770	5.9	269500	3122	5290	66570	0.74	162	36.9	0.12	0.76	0.75	211925
RF-09	6/17/14	1.64	0	2.52	94350	36840	77.8	2561	8.9	352500	2843	6051	82290	0.78	551.9	175.4	0.46	1.23	1.01	288262
LCKY-01	6/18/14	0.75	0	0	119600	10190	26	2825	15.9	74500	6163	3802	29140	1.19	161.9	35.8	0.07	0.33	0.71	119911
LCKY-02	6/18/14	0.88	0	0	24900	8974	52.3	2374	6.5	49150	6847	2645	26420	0.48	77.7	7.8	0.07	0.39	0.46	105755
LCKY-03	6/18/14	0	0	0	24060	8644	26	2330	4.2	47250	6683	2592	25210	0.44	27.9	2.1	0	0.24	0.17	79603
LCKY-04	6/18/14	0	0	0	21160	8442	34.3	2302	3.5	47010	7507	2550	23950	0.36	41.3	4.6	0	0.25	0.23	93831
LCKY-05	6/18/14	0.97	0	0	20900	8329	109.8	2353	9.6	46970	7361	2474	23600	0.38	186.4	25.2	0.24	0.52	0.69	78397
LCKY-06	6/18/14	0	0	0	20610	8474	46.4	2223	4.3	46170	7597	2593	24130	0.36	70.4	6.9	0.07	0.28	0.32	200387

YC-01	6/18/14	0.31	0	0	69310	10160	63.4	2040	6.5	58380	5024	3781	28570	0.85	57.4	4.3	0.07	0.44	0.79	201965
YC-02	6/18/14	0	0	0	74320	10510	75.8	2054	6.9	58190	5008	3843	29440	0.94	60	4.2	0.07	0.41	0.63	238110
YC-03	6/18/14	0	0	0	83570	10810	94.5	2387	7.9	57020	3368	3982	29970	1.01	66.5	3.6	0.05	0.37	0.52	258290
YC-04	6/18/14	0	0	0	86350	10660	108.1	2605	10.6	61270	3319	3868	29430	1.1	75.1	3.8	0.05	0.38	0.48	216087
YC-05	6/18/14	0	0	0	91220	10530	83.5	2914	13.5	67890	3521	3792	28650	0.57	72	5.7	0.08	0.39	0.49	376932
YC-06	6/18/14	0.77	0	0	129700	10930	169.9	3105	25.4	73600	2460	3885	31990	1.43	161.8	14.5	0.19	0.52	0.71	354206
YC-07	6/18/14	1.21	0	0	127000	10660	234.3	3136	29.6	75530	2578	3705	30870	1.45	286.9	36.6	0.42	0.75	1.14	190007
YC-08	6/18/14	2.03	0	0	41930	16950	116.5	2865	5.5	91320	797.6	4596	40080	0.76	168.4	16.2	0.33	0.84	0.98	188203
CC-01	7/21/14	3.64	0	2.42	33880	23010	137.2	2659	5	162400	3418	4318	56030	0.34	335.7	25.7	0.26	1.34	0	191670
CC-02	7/21/14	1.92	0	2.47	34640	23280	143.2	2687	5.1	165000	3360	4326	56140	0.25	338.2	28.1	0.27	1.3	0	184487
CC-03	7/21/14	1.51	0	2.22	39460	23870	124.6	2603	3.7	175700	3640	4357	57410	0.21	315.2	26.5	0.24	1.24	3.95	181010
CC-04	7/21/14	1.85	0	2.51	41670	22800	122.1	2649	0	170500	3549	4391	56040	0.22	283.2	22.2	0.21	1.26	0	198048
CC-05	7/21/14	1.76	0	1.97	36440	17610	100.5	2712	0	130200	3709	3320	46070	0.17	239.6	15.7	0.15	0.85	0	170351
CC-06	7/21/14	1.8	0	1.71	36630	17710	125.4	2777	4.7	129500	3546	3293	45910	0.2	282.9	20.5	0.21	0.99	0	200367
CC-07	7/21/14	2.42	0	0.96	30860	14060	139.6	2847	4.9	102800	3686	2964	40520	0.21	308.7	25.8	0.21	0.83	0	166261
CC-08	7/21/14	1.92	0	1.37	31890	14290	132.6	2737	4	105600	3504	2981	42010	0.22	307.4	27.8	0.22	0.87	0	183330
CC-09	7/21/14	2.75	0	1.18	39860	14610	147.3	2726	4	118400	3329	3093	42230	0.21	338.8	30.9	0.23	0.91	0	141710
CC-10	7/21/14	2.32	0	0	14560	14150	206	2797	5.4	83360	3095	2697	41760	0.29	501.6	39.8	0.32	0.99	0	134193
CC-11	7/21/14	0.63	0	8.62	383300	28200	46.9	2949	0	685700	7350	8793	64250	0.12	90.3	7.6	0.09	1.23	0	150986
CC-12	7/21/14	2.54	0	2.03	37800	18650	122.4	2854	4.3	135700	3844	3457	48150	0.19	288.9	20.9	0.2	0.92	0	159367
CC-13	7/21/14	2.08	0	2.41	37710	29960	108.6	2406	3.8	218400	2909	5641	70940	0.19	251.9	25	0.23	1.74	0	126738
CC-14	7/21/14	2.01	0	3.17	40080	31180	92.8	2293	0	229800	3043	5851	73290	0.16	209.3	21.2	0.18	1.69	0	141504
CC-15	7/21/14	3.81	0	3.06	44240	34150	135.7	2256	3.5	255300	2858	6335	79940	0.25	321.5	34.6	0.28	2.45	0	114581
LCVA-01	7/21/14	4.01	0	1.44	46240	26800	119.7	2733	6.5	177100	8667	3815	58820	0.22	351.2	55.3	0.21	0.95	0	119634
LCVA-02	7/21/14	2.26	0	1.63	47260	27590	177.7	2856	11.2	179700	8610	3873	60160	0.29	470.7	82.5	0.31	1.09	0	127738
LCVA-03	7/21/14	2.91	0	1.51	46950	27560	219.2	2850	11.7	180600	8550	3852	60150	0.34	590.8	106.7	0.37	1.26	0	97904
LCVA-04	7/21/14	12.68	0	1.56	46960	28900	169.3	2686	12.5	187900	8040	3954	61460	0.28	523.2	137.7	0.47	1.25	0	431188
LCVA-05	7/21/14	7.49	0	1.34	47950	25260	120.1	2549	8.3	172700	8035	3748	57080	0.2	380.7	111.6	0.31	1.22	0	141903
LCVA-06	7/21/14	2.32	0	1.44	43690	23350	242.2	2649	7	157700	8591	3613	53190	0.39	618.6	79.3	0.41	1.21	0	145738
LCVA-07	7/21/14	0	0	0	122600	33040	2.6	3525	17.4	232800	4591	4914	76060	0	47.5	208.4	0	0.51	0	155505
LCVA-08	7/21/14	2.91	0	1.93	29530	21630	265.9	2497	8.4	141100	8174	3399	47570	0.44	716.8	77.3	0.51	1.39	0	163138
RF-01	7/21/14	3.36	3.05	17.21	52800	41860	123.5	2479	17	297500	2146	5336	82010	0.61	382.6	55.9	0.74	3.12	1.51	162438
RF-02	7/21/14	2.2	0.24	4.53	53800	42830	94.7	2453	5	308300	2061	5407	85030	0.15	326.4	56.5	0.34	1.59	0	170531
RF-03	7/21/14	3.47	0	4.43	50920	44510	32.1	2335	0	321100	1907	5545	88310	0.07	119.1	27.1	0.17	1.46	0	159905

RF-04	7/21/14	1.65	0	4.44	56080	46010	87.3	2418	0	349000	2047	5749	94690	0.15	299.7	57.3	0.36	1.81	0	165849
RF-05	7/21/14	6.65	0	4.55	58140	46760	45.7	2346	0	379700	2076	5833	96120	0.09	230.9	42.6	0.27	1.72	0	167478
RF-06	7/21/14	0.74	0	4.27	65210	29360	44.6	2552	0	253200	2646	4879	67550	0.08	181.8	25.5	0.13	1.34	0	138630
RF-07	7/21/14	0	0	2.64	47470	56800	18.5	2109	0	442700	1398	5859	110500	0.05	52.8	21.7	0.2	1.51	0	332480
RF-08	7/21/14	2.45	0	4.61	62620	26620	46.2	2593	0	246200	2633	4822	64970	0.07	173.5	39.1	0.14	0.95	0	110353
RF-09	7/21/14	0.94	0	5.13	72410	31940	84.8	2476	0	303800	2443	5466	76460	0.15	356.3	70.3	0.27	1.22	0	168329
LCKY-01	7/22/14	5.48	0	0	41840	6898	201.2	2632	21.9	42610	5830	2449	20460	0.31	436.5	29.8	0.29	0.71	0	57878
LCKY-02	7/22/14	6.79	0	0	14620	6197	227	2445	6.3	32630	6688	1975	17930	0.62	460.3	21.5	0.32	0.82	0	56702
LCKY-03	7/22/14	2.83	0	0	14520	6258	233.8	2394	5.4	32940	7060	1989	17960	0.38	449.2	22.2	0.34	0.79	0	60650
LCKY-04	7/22/14	1.79	0	1.06	14150	6490	214.9	2285	6	34040	8057	2041	18380	0.29	419.2	22.9	0.33	0.8	0	56971
LCKY-05	7/22/14	2.29	0	1.06	14240	6438	199.2	2296	5.1	34340	7756	2021	18080	0.29	395	18.2	0.28	0.76	0	54660
LCKY-06	7/22/14	1.95	0	1.45	14170	6628	220.1	2267	6.4	35420	8709	2096	18570	0.3	425.1	21.7	0.34	0.81	0	88342
YC-01	7/22/14	8.62	0	0	21790	7702	330	3131	13.1	39900	3034	2540	22710	0.49	644.3	32.6	0.55	1.16	0.31	99133
YC-02	7/22/14	11.22	0	0	22430	7893	251.8	3013	13.2	40320	2699	2546	22550	0.37	497.8	31.4	0.42	0.88	0.32	99174
YC-03	7/22/14	0	0	0.82	24480	7683	46.1	2778	5.8	40390	2064	2538	22020	0.09	74.5	2.9	0.05	0.31	0	117596
YC-04	7/22/14	6.8	0	0	28560	8150	173.7	2774	11.5	43430	1953	2655	23530	0.22	324.8	31.4	0.39	0.76	0	129577
YC-05	7/22/14	8.98	0	0	34610	7724	183.9	2679	10.6	42940	1662	2541	22680	0.25	347.1	28.5	0.41	0.84	0	181342
YC-06	7/22/14	8.02	0	1.07	62310	9305	277.7	2684	20.9	59300	1516	2986	28460	0.4	514.9	46.9	0.64	1.12	0.16	167858
YC-07	7/22/14	8.99	0	0	52740	8857	281.6	2708	20.3	53900	1510	2874	26860	0.39	534.1	46.8	0.65	1.18	0.28	88091
YC-08	7/22/14	8.99	0	1.08	14220	9150	176.5	2634	5.8	47100	494300	2688	25900	0.28	328.9	22.8	0.43	1	0	172688
CC-01	8/12/14	0	0	1.22	32720	17260	36.2	1974	0	125300	3222	4110	44190	0.08	48.7	0.8	0	0.8	0	144734
CC-02	8/12/14	0	0	1.38	36030	19220	26.8	2017	0	142800	3260	4435	48270	0.07	33.5	0.7	0	0.77	0	162989
CC-03	8/12/14	0	0	1.75	43550	19990	29.9	2180	0	154800	3552	4506	50440	0.08	34.8	0.8	0	0.91	0	155853
CC-04	8/12/14	0	0	1.79	42930	18290	25.7	2211	0	140800	3125	4264	48000	0.08	28.6	0.7	0	0.82	0	158667
CC-05	8/12/14	0.36	0	2.17	35990	15670	29.5	2208	0	113800	3579	3874	43000	0.08	21.8	0.5	0	0.62	0	123387
CC-06	8/12/14	0.25	0	1.66	35980	15660	28.6	2163	0	114800	3688	3895	42840	0.07	23.2	0.5	0	0.67	0	170496
CC-07	8/12/14	0	0	1.31	29760	13060	35.9	2184	0	92730	3663	3606	38950	0.06	29.6	0.6	0	0.62	0	107550
CC-08	8/12/14	0	0	0.98	21590	11970	35.7	2452	0	78830	2812	3192	33910	0.08	36.7	1.1	0	1.47	0	126885
CC-09	8/12/14	0.28	0	1.14	31380	13060	30.7	2137	0	93590	3629	3590	38870	0.07	24.3	0.7	0	0.57	0	133879
CC-10	8/12/14	1.18	0	1.37	25450	13420	34.5	2151	0	88860	3615	3583	39680	0.08	24.1	0.8	0	0.62	0	123087
CC-11	8/12/14	0.54	0	2.02	200200	12470	131.7	2487	5.4	254700	4167	6235	32090	0.18	166.6	2.9	0.11	1.14	0.83	144656
CC-12	8/12/14	1.83	0	1.6	35110	15580	29.9	2230	0	112900	3551	3816	42660	0.08	23.2	0.5	0	0.63	0	141152
CC-13	8/12/14	1.05	0	1.32	32190	21250	42.2	2114	0	153900	2184	4604	53530	0.08	48	1.5	0	1.05	0	127848
CC-14	8/12/14	1.08	0	1.25	36750	22950	24.6	2041	0	170400	2315	4912	57400	0.07	31.8	1.4	0	1.17	0	129152

CC-15	8/12/14	1.63	0	1.73	46310	26630	24.1	1954	0	206400	2475	5522	65790	0.07	27.3	2.9	0	1.42	0	127881
LCVA-01	8/12/14	0	0	0.91	102400	39940	13.6	3162	0	272100	6378	5260	83580	0.07	45.8	8.6	0	0.62	0	97669
LCVA-02	8/12/14	0	0	0	102600	39930	10.4	3104	0	271300	6282	5213	83430	0.05	29.5	6.3	0	0.7	0	123865
LCVA-03	8/12/14	0	0	0	101700	40140	14.3	3096	0	275000	6607	5339	84140	0.07	36.7	9	0	0.62	0	117338
LCVA-04	8/12/14	0	0	0	88180	33970	32	2711	0	239300	6124	4745	76850	0.07	100.5	33.6	0.09	0.74	0	252670
LCVA-05	8/12/14	0	0	0	89820	31730	21.9	2755	3.6	225200	5668	4574	74260	0.06	57	46.3	0	0.61	0	129244
LCVA-06	8/12/14	0	0	0	93510	29890	31	2797	6.7	216800	5784	4512	70710	0	39.9	117.5	0	0.51	0	126738
LCVA-07	8/12/14	0	0	0	130300	32310	1.1	3521	16.4	222200	4895	4977	74690	0.08	30	201.9	0	0.43	0	138969
LCVA-08	8/12/14	1.75	0	2.87	63570	41290	211.7	2242	8.9	315400	5956	5303	90080	0.35	636.9	80.2	0.43	1.46	0	150000
RF-01	8/12/14	0	0	1.62	43550	27090	50.2	2120	0	191500	1916	4298	57060	0.05	63.6	1.2	0.06	1.11	0	258785
RF-02	8/12/14	0.23	0	1.67	43200	28440	42.2	2224	0	196000	1892	4399	59000	0.07	53.9	5	0.09	1.14	0	261195
RF-03	8/12/14	0.44	0	1.98	41990	32240	21	2241	0	219500	1835	4627	66680	0	26.5	3.2	0.07	1.1	0	254212
RF-04	8/12/14	1.19	0	1.97	44020	31680	16.2	2365	0	229300	1914	4598	68720	0.05	17.2	3.2	0.08	1.27	0	271079
RF-05	8/12/14	1.39	0	2.15	45590	34090	13	2376	0	246700	2153	4785	72690	0	8.9	11.8	0.11	1.29	0	277069
RF-06	8/12/14	0.53	0	1.67	43060	22220	16.4	2552	0	167000	3130	3898	52060	0	44.4	9.2	0	0.87	0	277499
RF-07	8/12/14	0	0	1.84	43100	42820	22.1	2255	0	302000	1393	5112	85710	0.05	16	10.7	0.16	1.62	0	348614
RF-08	8/12/14	0.29	0	1.49	37520	19310	20.2	2615	0	148800	3444	3641	47880	0	59.3	5.2	0	0.57	0	175260
RF-09	8/12/14	1.29	0	1.89	43580	23100	148.9	2597	4.2	185400	4684	4088	56530	0.21	492.2	53.6	0.23	1.07	0	264566
LCKY-01	8/13/14	0.88	0	0	122400	10780	65.3	3059	19.7	82880	7172	3898	30430	0.11	211.3	35.1	0.07	0.28	0	87352
LCKY-02	8/13/14	0.87	0	0	25560	8413	82.7	2347	0	49810	6453	2518	24820	0.16	156.3	8.2	0.1	0.37	0	79395
LCKY-03	8/13/14	0	0	0	23780	8038	26.9	2297	0	47560	7581	2381	23420	0.07	34.7	2.6	0	0.16	0	69917
LCKY-04	8/13/14	0.55	0	0	21370	8032	85.6	2319	3.3	47460	8600	2370	22390	0.14	170.3	8.3	0.1	0.38	0	77250
LCKY-05	8/13/14	1.12	0	0	21280	8017	67.3	2323	0	47460	8502	2395	22700	0.1	124.3	6.7	0.08	0.33	0	57951
LCKY-06	8/13/14	0.96	0	0	20840	8073	105.1	2303	4	47360	9025	2402	22470	0.16	211.1	13.3	0.14	0.41	0	167674
YC-01	8/13/14	0.58	0	0	52140	10240	95.7	2313	0	59300	4297	3483	29670	0.15	139.7	7.9	0.12	0.45	0	179183
YC-02	8/13/14	0.44	0	0	55690	10760	94.2	2179	0	60040	4172	3529	30850	0.14	139	11.4	0.11	0.48	0	190411
YC-03	8/13/14	0.51	0	0	62460	10890	104.6	2369	0	61610	2915	3494	30380	0.14	160.4	11.4	0.13	0.43	0	214391
YC-04	8/13/14	0.75	0	0	70940	11360	131.1	2421	4	66580	2870	3634	31870	0.19	208.7	14.9	0.19	0.51	0	250635
YC-05	8/13/14	0.86	0	0	79550	11250	135.9	2585	8.5	67560	2676	3697	31340	0.2	221.2	13.1	0.2	0.53	0	295017
YC-06	8/13/14	0	0	1.34	113200	11370	63.1	2663	11.8	79560	2517	3686	34230	0.1	75.8	4	0.06	0.27	0	297838
YC-07	8/13/14	0	0	1.18	112900	11320	71	2676	11.6	79460	2646	3649	33940	0.14	94.8	5.1	0.07	0.37	0	174705
YC-08	8/13/14	0	0	0.85	40060	15840	37	2597	0	83890	767.8	4274	39420	0.06	45.9	1.6	0	0.34	0	167930

Table A-4. Water quality parameter values at biomonitoring sites

Published ID	Date	CONDUCT	pH	DO	TEMP
CC-B01	9/25/2013	924	8.26	10.75	15.5
CC-B01	9/11/2012	1001	8.18	9.44	14.6
CC-B01	3/19/2014	578.7	8.12	13.38	7.7
CC-B01	4/2/2013	613	8.51		12.3
CC-B02	10/4/2011	1046	8.32	10.3	13.6
CC-B02	2/28/2012	627.6	8.36	13.29	9
CC-B02	8/28/2012	1013	8.15	9.81	16.1
CC-B02	9/16/2013	1049	8.01	11.46	15.2
CC-B02	3/10/2014	719.5	7.9	0	7.5
CC-B02	2/19/2013	857	8.56	12.08	8.7
CC-B03	2/24/2012	518.5	8.33	14.04	6.7
CC-B03	10/4/2011	792	8.38	10.58	12
CC-B03	8/21/2012	843	8.56	9.59	19.1
CC-B03	9/16/2013	932	8.22	10.57	16.1
CC-B03	3/11/2014	373.3	8.37	0	7.3
CC-B03	2/19/2013	628.3	8.51	12.43	4.2
CC-B04	2/28/2012	536	8.21	14.11	6.2
CC-B04	10/4/2011	821	8.32	8.82	12.2
CC-B04	3/11/2014	357.5	8.16	0	8.8
CC-B04	8/28/2012	874	8.33	9.93	18.2
CC-B04	9/16/2013	1020	8.12	10.29	16.4
CC-B04	2/19/2013	400.8	8.41	13.72	4.4
CC-B05	2/15/2012	511.2	8.21	13.47	8.8
CC-B05	2/19/2013	539	8.27	12.75	4.4
CC-B05	9/19/2013	780	7.9	10.38	16.5
CC-B05	8/21/2012	506.3	7.48	9.29	17.5
CC-B05	3/11/2014	425.4	8.06	0	10.3
CC-B07	9/18/2013	772	8.27	11.01	15.1
CC-B07	8/21/2012	775	8.52	8.56	19.2
CC-B07	10/4/2011	758	8.5	10.2	13.8
CC-B07	2/17/2012	404.5	8.25	13.15	7.4
CC-B07	3/13/2014	376.4	8.42	0	4
CC-B07	2/19/2013	466	8.4	12.06	6.3
CC-B08	9/16/2013	860	8.29	10.05	17.1
CC-B08	2/28/2012	498.6	8.24	14.12	5.9
CC-B08	8/28/2012	788	8.47	9.63	16.9
CC-B08	10/21/2011	521	8.24	12.09	9.1
CC-B08	3/13/2014	408.7	8.27	0	4.1
CC-B08	2/19/2013	580.2	8.53	12.56	5.4
CC-B09	8/21/2012	743	8.42	9.85	15.6
CC-B09	2/19/2013	468.4	8.45	12.33	5.3

CC-B09	9/19/2013	843	8.18	11.48	14.1
CC-B09	2/15/2012	405	8.21	13.41	7.8
CC-B09	3/13/2014	314.5	8.35	0	4.7
CCMB-B01	8/21/2012	213.6	8.01	8.76	18.6
CCMB-B01	10/7/2013	256.1	7.38	9.2	15.8
CCMB-B01	10/4/2011	243.7	8.04	9.1	11.2
CCMB-B01	2/19/2013	194.4	7.43	13.51	2.5
CCMB-B01	2/28/2012	226.6	7.86	13.9	5.9
CCMB-B01	3/6/2014	173.4	8.16	14.37	6
CCML-B01	9/11/2013	1003	8.4	9.06	18.7
CCML-B01	2/17/2012	744	8.46	11.79	10.6
CCML-B01	3/10/2014	749	7.86	0	8.5
CCML-B01	8/23/2012	982	8.38	9.33	19.5
CCML-B01	8/22/2011	704	8.24	8.85	20.7
CCML-B01	2/18/2013	848	8.44	13.85	6
CCML-B02	9/11/2013	1011	8.64	9.93	19
CCML-B02	3/10/2014	796	8.15	0	12.2
CCML-B02	2/17/2012	788	8.5	12.42	11
CCML-B02	8/23/2012	1027	8.49	10.05	19
CCML-B02	8/22/2011	733	8.28	7.36	20.8
CCML-B02	2/18/2013	905	8.67	12.46	7.7
CCMLHB-B01	8/22/2011	431.8	7.64	6.99	20.1
CCMLHB-B01	9/11/2013	409.6	8.38	12.94	5.4
CCMLHB-B01	8/26/2012	479.7	7.72	9.52	16.9
CCMLHB-B01	3/6/2014	354	7.87	16.33	6.9
CCMLHB-B01	2/17/2012	437.2	8.01	12.26	9.2
CCMLHB-B01	2/18/2013	409.6	8.38	12.94	5.4
CCWF-B01	8/21/2012	396.4	8.27	9.52	16.7
CCWF-B01	9/28/2013	358.8	7.83	9.58	15
CCWF-B01	8/22/2011	319.4	8.09	7.66	18.7
CCWF-B01	2/15/2012	306	8.23	13.71	7
CCWF-B01	4/17/2014		8.21		7.2
CCWF-B01	2/19/2013	282.6	8.4	12.86	4.6
LCKY-B01	9/11/2012	949	7.7	8.57	16.7
LCKY-B01	9/25/2013	369	7.7		9.4
LCKY-B01	3/19/2014	364.9	7.94	12.55	9
LCKY-B01	4/2/2013	369	7.7		9.4
LCKY-B02	9/25/2013	212	7.93		7.4
LCKY-B02	9/11/2012	252	7.8	8.3	14.8
LCKY-B02	3/19/2014	209.2	8.18	13.94	6.2
LCKY-B02	4/2/2013	212	7.93		7.4
LCVA-B01	9/11/2012	994	8.26	9.09	14.6
LCVA-B01	3/19/2014	711.6	8.24	12.37	9.4

LCVA-B01	4/2/2013	679	8.61		12.7
LCVA-B01	9/25/2013	1014	8.29	10.91	14.6
LCVA-B02	10/5/2011	1513	8.5	10.51	13.4
LCVA-B02	9/18/2013	826	8.02	10.39	15.1
LCVA-B02	3/6/2012	1031	8.57	11.86	9.7
LCVA-B02	8/28/2012	960	8.38	8.71	22.4
LCVA-B02	2/28/2014	573.8	8.19	14.98	6.8
LCVA-B02	2/21/2013	583	8.69	12.79	6
LCVA-B03	9/18/2013	902	8.04	10.72	15.7
LCVA-B03	8/21/2012	978	8.34	8.66	18.5
LCVA-B03	3/7/2012	1077	8.53	11.58	10.2
LCVA-B03	10/5/2011	1580	8.49	9.81	13
LCVA-B03	2/21/2013	533	8.47	12.42	5.8
LCVA-B03	2/28/2014	528.7	7.98	14.88	5.7
LCVA-B04	3/7/2012	1201	8.53	11.58	10.3
LCVA-B04	8/28/2012	1029	8.25	8.59	19.4
LCVA-B04	9/18/2013	883	7.93	9.97	16.1
LCVA-B04	10/5/2011	1705	8.44	9.42	13.2
LCVA-B04	2/28/2014	590.8	7.99	15.93	4.4
LCVA-B04	2/21/2013	571.6	3.3	12.84	4.4
RF-B01	9/25/2013	1233	8.27	10.41	15.6
RF-B01	9/10/2012	1250	8.25	8.55	16.3
RF-B01	4/2/2013	946	8.41		11.2
RF-B01	3/19/2014	852	7.9	12.82	8.2
RF-B02	9/10/2012	1316	8.15	8.32	18.1
RF-B02	10/2/2013	1345	8.46	10.29	14.8
RF-B02	3/14/2012	1107	8.32	12.35	11.3
RF-B03	9/25/2013	1336	8.17	10.03	15.8
RF-B03	9/10/2012	1316	8.15	8.32	18.1
RF-B03	4/2/2013	1096	8.44		12.2
RF-B03	3/19/2014	1037	8.11	13.12	8.1
RFPF-B01	4/2/2013	387	8.24		11.9
RFPF-B01	9/10/2012	1136	8.08	7.99	18
RFPF-B01	3/19/2014	611.3	8.11	13.26	7.7
RFPF-B01	9/25/2013	1251	8.25	10.18	15.7
RFPF-B02	2/15/2012	1020	8.28	14.36	5.5
RFPF-B02	10/14/2011	1272	8.23	10.72	12.1
RFPF-B02	3/14/2014	962	8.16	0	4.3
RFPF-B02	9/19/2013	1133	8.13	11.39	15.9
RFPF-B02	2/21/2013	678	8.43	13.43	2.7
RFPF-B02	8/23/2012	1141	8.41	9.24	19.1
RFPF-B03	3/6/2012	1137	8.1	12.04	8.4
RFPF-B03	10/14/2011	1338	8.22	10.26	14.5

RFPF-B03	8/23/2012	1539	8.19	9.52	15.6
RFPF-B03	3/14/2014	1204	8.25	0	7
RFPF-B03	9/19/2013	1518	8.12	10.99	16
RFPF-B03	2/21/2013	1084	8.46	11.73	10.9
RFPF-B04	2/15/2012	1271	8.02	12.78	9.4
RFPF-B04	10/2/2013	1609	8.18	9.82	16.6
RFPF-B04	9/6/2012	1640	7.6	6.79	21
RFPFWF-B01	2/15/2012	353.3	8.3	14.41	5.3
RFPFWF-B01	9/19/2013	441.8	8.03	11.01	16.6
RFPFWF-B01	10/14/2011	461.6	8.37	10.94	9.6
RFPFWF-B01	8/23/2012	456.8	8.39	9.86	14.6
RFPFWF-B01	3/14/2014	310.6	8.34	0	4
RFPFWF-B01	2/21/2013	340	8.19	14.01	1.3
YC-B01	4/2/2013	233	8.27		8.3
YC-B01	3/19/2014	238.8	8.22	12.79	10
YC-B01	9/25/2013	529.6	8.51	10.76	17.9
YC-B01	9/11/2012	530	8.66	9.11	21.4
YC-B02	3/19/2014	362.7	8.38	12.26	10.7
YC-B02	9/11/2012	697	8.55	8.42	18.6
YC-B02	9/25/2013	342	8.53		7.7
YC-B02	4/2/2013	342	8.53		7.7
YC-B03	9/25/2013	563.7	8.41	10.3	16.1
YC-B03	4/2/2013	336	3.45		7
YC-B03	9/11/2012	558	8.32	8.48	16.8
YC-B03	3/19/2014	240	8.24	12.32	9.8
YC-B04	9/25/2013	772	8.66	10.13	16
YC-B04	3/19/2014	502.1	8.32	12.46	10.3
YC-B04	9/11/2012	787	8.57	8.25	17.2
YC-B04	4/2/2013	58.5	8.54		6.7

Table A-5. Habitat assessment metrics at biomonitoring sites

Published ID	Date	Alter	Banks	Bankveg	Embed	Flow	Riffles	Ripveg	Sediment	Substrate	Velocity	HabScore
CCML-B01	8/22/11	17	16	17	15	17	14	16	14	17	14	157
CCML-B02	8/22/11	11	15	14	10	16	13	10	12	10	13	124
CCMLHB-B01	8/22/11	14	16	16	14	15	15	16	14	15	13	148
CCWF-B01	8/22/11	13	14	14	13	14	15	9	10	13	10	125
CC-B02	10/4/11	13	13	14	15	9	13	13	10	13	10	123
CC-B03	10/4/11	14	14	14	12	14	14	11	11	14	10	128
CC-B04	10/4/11	13	14	13	13	13	12	3	13	12	11	117
CC-B07	10/4/11	17	16	15	14	12	8	11	14	12	9	128
CCMB-B01	10/4/11	12	13	5	13	8	13	3	10	10	8	95
LCVA-B02	10/5/11	14	13	14	11	11	14	14	10	14	10	125
LCVA-B03	10/5/11	12	13	12	11	15	13	11	10	13	14	124
LCVA-B04	10/5/11	14	13	14	13	15	15	11	10	15	11	131
RFPF-B02	10/14/11	17	16	14	14	17	14	12	14	13	13	144
RFPF-B03	10/14/11	16	14	12	13	13	12	11	11	12	9	123
RFPFWF-B01	10/14/11	17	16	18	14	14	13	18	16	17	9	152
CC-B08	10/21/11	12	16	12	12	16	14	7	12	15	10	126
CC-B05	2/15/12	15	11	13	14	15	13	14	12	13	10	130
CC-B09	2/15/12	13	13	13	14	15	15	12	13	14	11	133
CCWF-B01	2/15/12	12	15	12	12	15	15	10	12	13	7	123
RFPF-B02	2/15/12	14	12	12	14	15	15	12	10	14	11	129
RFPF-B04	2/15/12	12	12	11	13	15	13	9	9	12	11	117
RFPFWF-B01	2/15/12	15	11	16	15	15	13	17	14	15	13	144
CC-B07	2/17/12	14	14	13	14	15	11	10	14	13	12	130
CCML-B01	2/17/12	14	16	17	13	15	15	15	13	15	10	143
CCML-B02	2/17/12	13	13	10	11	15	12	10	12	16	14	126
CCMLHB-B01	2/17/12	14	16	16	14	15	15	16	14	15	13	148
CC-B03	2/24/12	16	14	14	12	15	16	16	13	13	12	141
CC-B02	2/28/12	14	16	16	15	16	13	14	16	16	13	149
CC-B04	2/28/12	12	12	8	14	15	15	3	12	13	10	114
CC-B08	2/28/12	13	14	8	11	15	16	6	14	12	10	119
CCMB-B01	2/28/12	12	18	4	18	15	11	2	16	16	10	122
LCVA-B02	3/6/12	11	12	12	12	15	12	16	12	17	10	129

RFPF-B03	3/6/12	13	12	12	12	15	10	14	14	13	10	125
LCVA-B03	3/7/12	11	10	10	12	15	13	11	11	17	13	123
LCVA-B04	3/7/12	15	12	12	12	15	12	10	12	16	12	128
RF-B02	3/14/12	11	8	13	13	15	11	9	10	14	13	117
CC-B03	8/21/12	13	14	14	14	15	15	14	13	15	10	137
CC-B05	8/21/12	13	11	15	12	15	12	15	11	14	10	128
CC-B07	8/21/12	10	12	11	13	15	14	12	12	15	10	124
CC-B09	8/21/12	12	14	16	15	15	14	17	13	16	11	143
CCMB-B01	8/21/12	10	14	9	12	15	11	5	10	12	10	108
CCWF-B01	8/21/12	11	12	15	14	15	12	12	11	15	10	127
LCVA-B03	8/21/12	13	14	13	14	15	14	13	10	15	10	131
CCML-B01	8/23/12	14	12	12	15	15	12	18	13	15	10	136
CCML-B02	8/23/12	11	14	16	12	15	11	9	11	14	10	123
RFPF-B02	8/23/12	13	13	13	14	15	14	14	10	16	10	132
RFPF-B03	8/23/12	11	14	13	13	15	12	12	13	14	10	127
RFPFWF-B01	8/23/12	13	12	14	11	15	14	18	7	15	10	129
CCMLHB-B01	8/26/12	14	14	12	14	15	15	13	10	15	12	134
CC-B02	8/28/12	14	14	16	12	15	14	14	12	15	13	139
CC-B04	8/28/12	13	12	12	14	15	14	8	13	15	12	128
CC-B08	8/28/12	13	12	12	13	15	14	9	11	14	13	126
LCVA-B02	8/28/12	17	16	18	13	15	11	17	12	13	10	142
LCVA-B04	8/28/12	14	13	14	13	15	14	15	10	15	10	133
RFPF-B04	9/6/12	11	12	10	14	15	10	13	10	13	10	118
RF-B01	9/10/12	18	16	18	14	15	16	17	15	16	18	163
RF-B02	9/10/12	16	12	16	14	15	12	12	14	16	10	137
RF-B03	9/10/12	16	14	12	13	15	9	12	15	14	10	130
RFPF-B01	9/10/12	16	14	13	15	15	11	12	14	13	10	133
CC-B01	9/11/12	11	14	12	14	15	15	9	13	15	10	128
LCKY-B01	9/11/12	5	18	8	14	15	12	8	9	15	12	116
LCKY-B02	9/11/12	14	16	16	15	15	13	17	14	16	10	146
LCVA-B01	9/11/12	11	14	11	15	15	12	15	12	14	10	129
YC-B01	9/11/12	11	14	10	14	15	11	8	14	15	10	122
YC-B02	9/11/12	11	12	10	13	15	12	7	11	14	10	115
YC-B03	9/11/12	11	14	14	14	15	13	13	10	13	10	127

YC-B04	9/11/12	14	16	14	14	15	13	18	11	15	10	140
CCML-B01	2/18/13	18	15	16	14	15	15	16	15	13	10	147
CCML-B02	2/18/13	15	16	17	14	10	12	14	10	12	16	136
CCMLHB-B01	2/18/13	13	14	14	14	15	13	16	11	13	11	134
CC-B02	2/19/13	15	13	15	13	15	15	16	14	15	10	141
CC-B03	2/19/13	13	14	16	13	15	13	14	12	14	10	134
CC-B04	2/19/13	13	16	14	13	15	12	7	12	13	11	126
CC-B05	2/19/13	11	13	15	12	15	12	15	10	13	10	126
CC-B07	2/19/13	12	15	14	13	15	12	11	12	13	10	127
CC-B08	2/19/13	13	15	16	11	15	12	6	11	12	10	121
CC-B09	2/19/13	13	14	16	13	15	14	16	13	14	11	139
CCMB-B01	2/19/13	12	13	13	14	15	13	7	13	12	10	122
CCWF-B01	2/19/13	10	13	15	12	15	12	10	12	14	10	123
LCVA-B02	2/21/13	13	16	16	13	15	12	14	12	13	10	134
LCVA-B03	2/21/13	12	16	14	13	15	13	12	11	15	12	133
LCVA-B04	2/21/13	12	15	16	13	15	13	14	12	14	12	136
RFPF-B02	2/21/13	12	14	15	13	15	12	13	11	14	12	131
RFPF-B03	2/21/13	10	14	13	13	15	12	11	12	13	10	123
RFPFWF-B01	2/21/13	16	15	16	12	15	13	17	10	13	10	137
CC-B01	4/2/13	11	14	11	12	15	12	9	11	14	10	119
LCKY-B01	4/2/13	6	18	13	11	15	13	8	11	14	12	121
LCKY-B02	4/2/13	15	16	17	14	15	14	18	14	16	12	151
LCVA-B01	4/2/13	12	15	13	12	15	12	14	13	14	10	130
RF-B01	4/2/13	16	16	16	14	15	15	17	13	17	13	152
RF-B03	4/2/13	12	15	15	14	15	12	11	11	14	10	129
RFPF-B01	4/2/13	12	15	13	12	15	12	14	12	15	10	130
YC-B01	4/2/13	11	13	14	13	15	12	11	13	12	10	124
YC-B02	4/2/13	11	11	13	13	15	12	9	11	13	10	118
YC-B03	4/2/13	11	13	14	14	15	11	13	12	13	10	126
YC-B04	4/2/13	14	16	16	12	15	13	17	12	15	10	140
CCML-B01	9/11/13	14	15	18	12	15	11	17	14	14	10	140
CCML-B02	9/11/13	11	16	17	14	15	14	12	12	13	11	135
CCMLHB-B01	9/11/13	13	14	14	14	15	13	16	11	13	11	134
CC-B02	9/16/13	13	14	16	14	15	14	15	11	14	10	136

CC-B03	9/16/13	13	16	18	12	15	14	14	11	14	10	137
CC-B04	9/16/13	11	14	14	12	15	13	8	10	13	11	121
CC-B08	9/16/13	11	14	16	13	15	13	10	11	13	10	126
CC-B07	9/18/13	11	16	11	14	15	13	12	11	13	10	126
LCVA-B02	9/18/13	13	16	15	14	15	12	15	11	14	10	135
LCVA-B03	9/18/13	11	14	17	11	15	14	12	11	15	11	131
LCVA-B04	9/18/13	13	15	17	13	15	14	15	10	15	10	137
CC-B05	9/19/13	11	16	16	11	15	13	12	10	14	10	128
CC-B09	9/19/13	10	15	16	14	15	14	18	12	15	11	140
RFPF-B02	9/19/13	11	14	14	14	15	14	12	12	15	11	132
RFPF-B03	9/19/13	11	13	13	13	15	11	12	12	13	10	123
RFPFWF-B01	9/19/13	16	16	16	14	15	14	18	10	15	10	144
CC-B01	9/25/13	11	14	13	14	15	13	8	13	15	10	126
LCKY-B01	9/25/13	6	18	13	11	15	13	8	11	14	12	121
LCKY-B02	9/25/13	15	16	17	14	15	14	18	14	16	12	151
LCVA-B01	9/25/13	12	15	13	13	15	14	12	14	14	11	133
RF-B01	9/25/13	14	16	18	13	15	15	18	13	16	13	151
RF-B03	9/25/13	11	13	14	14	15	13	9	12	13	10	124
RFPF-B01	9/25/13	11	14	10	13	15	13	12	11	13	10	122
YC-B01	9/25/13	11	16	13	14	15	13	11	14	14	10	131
YC-B02	9/25/13	11	11	13	13	15	12	9	11	13	10	118
YC-B03	9/25/13	11	15	14	13	15	13	12	12	13	10	128
YC-B04	9/25/13	14	16	16	12	15	13	17	12	15	10	140
CCWF-B01	9/28/13	11	16	14	12	15	13	11	11	13	10	126
RF-B02	10/2/13	11	16	16	13	15	12	10	11	14	10	128
RFPF-B04	10/2/13	11	14	11	13	15	13	12	11	13	10	123
CCMB-B01	10/7/13	11	16	10	13	15	11	5	14	13	10	118
LCVA-B02	2/28/14	13	15	11	11	15	15	12	9	13	10	124
LCVA-B03	2/28/14	14	14	12	12	15	15	10	14	15	15	136
LCVA-B04	2/28/14	14	14	13	12	15	15	9	12	16	14	134
CCMB-B01	3/6/14	11	14	3	14	15	15	3	11	12	10	108
CCMLHB-B01	3/6/14	16	14	18	13	15	15	14	13	14	13	145
CC-B02	3/10/14	13	14	16	15	15	15	15	13	15	10	141
CCML-B01	3/10/14	13	15	16	14	15	14	17	14	15	10	143

CCML-B02	3/10/14	11	16	15	13	15	12	12	13	13	11	131
CC-B03	3/11/14	13	14	18	14	15	13	15	14	15	10	141
CC-B04	3/11/14	11	14	16	14	15	13	10	11	14	10	128
CC-B05	3/11/14	11	14	16	13	15	13	14	11	14	10	131
CC-B07	3/13/14	11	16	16	11	15	15	11	11	14	10	130
CC-B08	3/13/14	11	16	14	12	15	13	8	11	14	10	124
CC-B09	3/13/14	11	16	14	14	15	14	14	15	16	11	140
RFPF-B02	3/14/14	11	14	14	13	15	13	14	13	15	11	133
RFPF-B03	3/14/14	11	14	14	13	15	11	12	11	15	10	126
RFPFWF-B01	3/14/14	16	16	16	13	15	14	18	12	15	10	145
CC-B01	3/19/14	13	13	13	13	15	12	8	14	14	11	126
LCKY-B01	3/19/14	10	18	14	14	15	14	8	14	15	11	133
LCKY-B02	3/19/14	16	14	14	14	15	15	18	13	16	10	145
LCVA-B01	3/19/14	13	15	13	13	15	12	12	14	14	11	132
RF-B01	3/19/14	15	16	16	14	15	14	18	13	16	13	150
RF-B03	3/19/14	13	13	14	13	15	12	9	11	13	11	124
RFPF-B01	3/19/14	13	13	13	12	15	11	12	12	13	10	124
YC-B01	3/19/14	13	16	13	13	15	12	12	13	13	11	131
YC-B02	3/19/14	13	12	11	13	15	13	8	13	14	11	123
YC-B03	3/19/14	11	14	14	13	15	13	13	13	14	10	130
YC-B04	3/19/14	16	16	16	15	15	14	18	14	17	10	151
CCWF-B01	4/17/14	11	16	14	13	15	13	10	12	14	10	128

Table A-6. Family-level organism identification at biomonitoring sites I

Published ID	Date	Aeshnidae	Ameletidae	Ancylidae	Asellidae	Athericidae	Baetidae	Calopterygidae	Cambaridae	Capniidae	Ceratopogonidae
CC-B01	9/11/12	0	0	0	0	1	24	0	0	0	0
LCVA-B01	9/11/12	0	0	0	89	0	15	0	0	0	0
RF-B01	9/10/12	0	0	0	0	2	15	0	0	0	0
RF-B03	9/10/12	1	0	0	0	0	0	0	1	1	0
RFPF-B01	9/10/12	0	0	0	0	0	3	1	0	0	0
LCKY-B01	9/11/12	1	0	0	0	2	14	0	0	0	0
LCKY-B02	9/11/12	0	0	0	2	8	2	0	0	1	1
YC-B01	9/11/12	0	0	0	0	1	18	0	0	0	0
YC-B02	9/11/12	0	0	0	0	2	19	0	0	0	0
YC-B03	9/11/12	0	0	0	0	6	18	0	0	0	0
YC-B04	9/11/12	0	0	0	1	2	9	0	1	0	0
RFPF-B02	8/23/12	1	0	0	0	0	2	0	1	0	0
RFPF-B03	8/23/12	0	0	0	0	0	1	0	3	0	0
RFPFWF-B01	8/23/12	0	0	0	0	0	7	0	1	0	0
CC-B05	8/21/12	0	0	0	0	2	5	0	0	0	0
CC-B09	8/21/12	0	0	0	0	0	30	0	1	0	0
CCWF-B01	8/21/12	0	0	0	0	0	13	0	1	0	0
RF-B02	9/10/12	0	0	0	0	0	1	0	2	0	0
RFPF-B04	9/6/12	0	0	0	0	0	1	0	2	0	1
LCVA-B02	8/28/12	1	0	0	33	0	28	1	3	0	0
LCVA-B03	8/21/12	0	0	0	0	0	0	0	3	0	0
LCVA-B04	8/28/12	0	0	0	0	0	0	0	4	0	0
CC-B02	8/28/12	0	0	0	0	0	6	0	0	0	0
CC-B03	8/21/12	0	0	0	0	0	3	0	1	0	0
CC-B04	8/28/12	0	0	0	0	0	11	0	2	0	0
CC-B08	8/28/12	0	0	0	0	0	9	0	2	0	0
CCMB-B01	8/21/12	0	0	0	0	0	16	0	2	0	0
CC-B07	8/21/12	0	0	0	0	0	18	0	2	0	0
CCMLHB-B01	8/26/12	0	0	0	0	0	1	0	0	0	0
CCML-B02	8/23/12	0	0	0	0	0	6	0	1	0	0
CCML-B01	8/23/12	0	0	0	0	1	16	0	0	0	0
LCVA-B03	10/5/11	0	0	0	0	0	7	0	0	0	0

LCVA-B04	10/5/11	0	0	0	0	0	14	0	0	0	0
LCVA-B02	10/5/11	0	0	0	0	0	0	0	0	0	0
CC-B02	10/4/11	0	0	0	0	0	14	0	0	0	0
CC-B03	10/4/11	0	0	1	0	1	31	0	0	0	0
CC-B04	10/4/11	0	0	0	0	0	19	0	1	0	0
CC-B08	10/21/11	0	0	0	0	0	1	0	1	34	0
CCMB-B01	10/4/11	0	0	0	0	0	14	0	3	17	0
CCWF-B01	8/22/11	0	0	0	0	0	27	0	3	0	0
CC-B07	10/4/11	0	0	0	0	0	43	0	1	10	0
RFPF-B02	10/14/11	0	0	0	0	0	0	0	0	1	0
RFPF-B03	10/14/11	0	0	0	0	0	0	0	1	0	0
RFPFWF-B01	10/14/11	1	0	0	0	0	3	0	0	4	1
CCMLHB-B01	8/22/11	0	0	0	0	0	0	0	0	0	0
CCML-B02	8/22/11	0	0	0	0	0	9	0	0	0	0
CCML-B01	8/22/11	1	0	0	0	1	7	0	0	0	0
LCVA-B03	3/7/12	0	0	0	0	0	20	0	0	0	0
LCVA-B04	3/7/12	0	0	0	0	0	6	0	0	0	0
LCVA-B02	3/6/12	0	0	0	2	0	10	0	0	0	0
CC-B02	2/28/12	0	0	1	0	0	17	0	0	0	0
CC-B03	2/24/12	0	1	0	0	0	9	0	0	0	0
CC-B04	2/28/12	0	0	0	0	0	4	0	0	0	0
CC-B08	2/28/12	0	0	0	1	0	30	0	0	0	0
CCMB-B01	2/28/12	0	9	0	0	0	11	0	0	0	0
CC-B05	2/15/12	0	1	0	0	0	14	0	0	0	0
CCWF-B01	2/15/12	0	4	0	0	0	12	0	0	0	0
CC-B07	2/17/12	0	11	0	0	0	22	0	0	1	0
RFPF-B02	2/15/12	0	0	0	0	0	0	0	0	0	0
RFPF-B03	3/6/12	0	0	0	0	0	1	0	0	0	0
RFPFWF-B01	2/15/12	0	3	0	0	0	8	0	0	0	0
RFPF-B04	2/15/12	0	0	0	0	0	0	0	0	0	0
RF-B02	3/14/12	0	0	0	0	0	2	0	0	0	0
CCMLHB-B01	2/17/12	0	4	0	0	0	10	0	0	1	0
CCML-B02	2/17/12	0	0	0	0	0	24	0	0	0	0
CCML-B01	2/17/12	0	0	0	0	0	16	0	0	0	0

CC-B09	2/15/12	0	0	0	0	0	77	0	0	0	1
LCVA-B03	2/21/13	0	1	0	0	0	0	0	0	0	0
LCVA-B04	2/21/13	0	3	0	0	0	9	0	0	0	0
LCVA-B02	2/21/13	0	0	0	1	0	36	0	0	0	0
CC-B02	2/19/13	0	0	0	0	0	30	0	0	0	1
CC-B03	2/19/13	0	0	0	0	0	48	0	0	0	1
CC-B04	2/19/13	0	0	0	0	0	30	0	0	0	0
CC-B08	2/19/13	0	4	0	0	0	26	0	0	0	1
CCMB-B01	2/19/13	0	8	0	0	0	8	0	0	0	0
CC-B09	2/19/13	0	0	0	0	0	77	0	0	0	1
CC-B05	2/19/13	0	1	0	0	0	14	0	0	0	0
CCWF-B01	2/19/13	0	3	0	0	0	1	0	0	0	0
CC-B07	2/19/13	0	16	0	0	0	31	0	0	0	0
RFPF-B02	2/21/13	0	0	0	0	0	0	0	0	0	0
RFPF-B03	2/21/13	0	0	0	0	0	0	0	1	0	1
RFPFWF-B01	2/21/13	0	2	0	0	0	8	0	0	0	0
CCMLHB-B01	2/18/13	0	4	0	0	0	3	0	0	0	0
CCML-B02	2/18/13	0	0	0	0	0	55	0	0	0	0
CCML-B01	2/18/13	0	0	0	0	0	42	0	0	0	0
CC-B01	4/2/13	0	0	0	0	0	24	0	1	0	0
LCVA-B01	4/2/13	0	0	0	80	0	22	0	0	0	0
RF-B01	4/2/13	0	0	0	0	0	4	0	0	0	0
RF-B03	4/2/13	0	0	0	0	0	0	0	1	0	0
RFPF-B01	4/2/13	0	0	0	0	0	9	0	0	0	0
LCKY-B01	4/2/13	0	0	0	0	0	4	0	1	0	0
LCKY-B02	4/2/13	0	3	0	0	0	2	0	0	0	2
YC-B01	4/2/13	0	0	0	1	1	18	0	0	0	0
YC-B02	4/2/13	0	0	0	0	0	68	0	0	0	0
YC-B03	4/2/13	0	2	0	0	1	46	0	0	0	1
YC-B04	4/2/13	0	0	0	0	1	54	0	0	0	0
LCVA-B03	9/18/13	0	0	0	0	0	0	0	1	0	0
LCVA-B04	9/18/13	0	0	0	0	0	0	0	3	0	2
LCVA-B02	9/18/13	0	0	0	48	0	0	0	2	0	0
CC-B02	9/16/13	0	0	0	0	0	24	0	0	0	0

CC-B03	9/16/13	0	0	0	0	7	9	0	1	0	0
CC-B04	9/16/13	0	0	0	0	1	13	0	0	0	0
CC-B08	9/16/13	0	0	0	0	0	11	0	0	0	0
CCMB-B01	10/7/13	0	0	0	0	0	9	2	2	8	0
CC-B09	9/19/13	0	0	0	0	0	9	0	1	0	3
CC-B05	9/19/13	0	0	0	0	1	2	0	2	0	0
CCWF-B01	9/28/13	0	0	0	0	0	0	0	4	0	1
CC-B07	9/18/13	0	0	0	0	0	6	0	0	0	0
RFPF-B02	9/19/13	0	0	0	0	0	4	0	2	0	0
RFPF-B03	9/19/13	0	0	0	0	0	0	2	0	0	0
RFPFWF-B01	9/19/13	0	0	0	0	0	10	0	1	20	0
CCMLHB-B01	9/11/13	0	0	0	0	0	1	0	0	0	0
CCML-B02	9/11/13	0	0	0	0	0	8	0	0	0	0
CCML-B01	9/11/13	0	0	0	0	0	16	0	2	0	0
CC-B01	9/25/13	0	0	0	0	0	24	0	2	0	0
LCVA-B01	9/25/13	0	0	0	64	0	18	0	0	0	0
RF-B01	9/25/13	0	0	0	0	0	14	0	1	0	0
RF-B03	9/25/13	0	0	0	0	0	0	0	1	0	0
RFPF-B01	9/25/13	1	0	0	0	0	1	0	2	0	0
LCKY-B01	9/25/13	0	0	0	0	2	10	0	0	0	0
LCKY-B02	9/25/13	0	0	0	0	24	15	0	1	0	0
YC-B01	9/25/13	0	0	0	0	0	9	0	0	0	0
YC-B02	9/25/13	0	0	0	0	1	14	0	2	0	0
YC-B03	9/25/13	0	0	0	0	2	22	0	0	0	0
YC-B04	9/25/13	0	0	0	0	3	50	0	0	0	0
RFPF-B04	10/2/13	0	0	0	0	1	0	0	2	0	0
RF-B02	10/2/13	0	0	0	0	0	0	0	1	0	0
LCVA-B03	2/28/14	0	0	0	0	0	2	0	0	0	0
LCVA-B04	2/28/14	0	0	0	0	0	0	0	0	0	1
LCVA-B02	2/28/14	0	0	0	3	0	0	0	0	0	0
CC-B02	3/10/14	0	0	0	0	0	17	0	1	0	0
CC-B03	3/11/14	0	1	0	0	0	33	0	0	0	0
CC-B04	3/11/14	0	2	0	0	1	9	0	0	0	0
CC-B08	3/13/14	0	0	0	0	0	8	0	0	0	0

CCMB-B01	3/6/14	0	4	0	0	0	0	0	1	5	0
CC-B09	3/13/14	0	4	0	0	0	26	0	0	0	0
CC-B05	3/11/14	0	2	0	0	0	5	0	0	0	0
CCWF-B01	4/17/14	0	5	0	0	0	4	0	0	0	0
CC-B07	3/13/14	0	5	0	0	0	27	0	0	0	0
RFPF-B02	3/14/14	0	0	0	0	0	0	0	0	0	0
RFPF-B03	3/14/14	0	2	0	0	0	0	0	0	0	0
RFPFWF-B01	3/14/14	0	5	0	0	0	2	0	0	0	0
CCMLHB-B01	3/6/14	0	5	0	0	0	1	0	0	0	0
CCML-B02	3/10/14	0	0	0	0	0	29	0	0	0	0
CCML-B01	3/10/14	0	0	0	0	0	30	0	0	0	0
CC-B01	3/19/14	0	0	0	0	0	14	0	0	0	0
LCVA-B01	3/19/14	0	0	0	80	0	4	0	0	0	0
RF-B01	3/19/14	0	0	0	0	1	3	0	0	0	0
RF-B03	3/19/14	0	0	0	0	0	0	0	0	0	0
RFPF-B01	3/19/14	0	0	0	0	0	4	0	0	0	0
LCKY-B01	3/19/14	0	0	0	0	0	2	0	0	0	0
LCKY-B02	3/19/14	0	1	0	0	1	5	0	1	0	0
YC-B01	3/19/14	0	0	0	0	0	14	0	0	0	0
YC-B02	3/19/14	0	0	0	0	0	9	0	0	0	1
YC-B03	3/19/14	0	0	0	0	0	27	0	0	0	1
YC-B04	3/19/14	0	0	0	0	1	32	0	0	0	0

Table A-7. Family-level organism identification at biomonitoring sites II

Published ID	Date	Chironomidae (A)	Chloroperlidae	Cordulegastridae	Corydalidae	Dixidae	Dryopidae	Dytiscidae	Elmidae	Empididae	Ephemerellidae
CC-B01	9/11/12	2	0	0	0	0	0	0	10	0	0
LCVA-B01	9/11/12	0	0	0	0	0	0	0	0	0	0
RF-B01	9/10/12	23	0	0	1	0	0	0	2	1	0
RF-B03	9/10/12	27	0	0	0	0	0	0	2	0	0
RFPF-B01	9/10/12	42	0	0	0	0	0	0	3	0	0
LCKY-B01	9/11/12	17	0	0	1	0	0	0	12	0	0
LCKY-B02	9/11/12	5	1	0	3	0	0	0	9	0	0
YC-B01	9/11/12	3	0	0	2	0	0	0	0	1	0
YC-B02	9/11/12	2	0	0	4	0	1	0	22	0	0
YC-B03	9/11/12	11	1	0	0	0	0	0	2	0	0
YC-B04	9/11/12	5	0	0	0	0	0	0	12	0	0
RFPF-B02	8/23/12	15	0	0	3	0	1	0	11	1	0
RFPF-B03	8/23/12	34	0	0	0	0	0	0	2	1	0
RFPFWF-B01	8/23/12	10	0	2	0	1	0	0	0	1	0
CC-B05	8/21/12	1	0	0	1	0	0	0	13	1	0
CC-B09	8/21/12	29	0	0	0	0	0	0	7	2	0
CCWF-B01	8/21/12	8	0	0	0	0	0	0	3	3	0
RF-B02	9/10/12	28	0	0	0	0	0	0	6	0	0
RFPF-B04	9/6/12	28	0	0	0	0	0	0	0	1	0
LCVA-B02	8/28/12	12	0	0	2	0	0	0	2	0	0
LCVA-B03	8/21/12	9	0	0	0	0	0	0	0	1	0
LCVA-B04	8/28/12	11	0	0	3	0	0	0	1	1	0
CC-B02	8/28/12	9	0	0	0	0	0	0	3	0	0
CC-B03	8/21/12	7	0	0	0	0	0	0	2	0	0
CC-B04	8/28/12	6	0	0	0	0	0	0	6	1	0
CC-B08	8/28/12	15	0	0	0	0	0	0	7	1	0
CCMB-B01	8/21/12	21	0	0	0	0	0	0	4	5	1
CC-B07	8/21/12	2	0	0	0	0	0	0	9	2	0
CCMLHB-B01	8/26/12	5	0	0	0	0	0	0	1	2	0
CCML-B02	8/23/12	19	0	0	0	0	0	0	14	0	0
CCML-B01	8/23/12	3	0	0	0	0	0	0	13	0	1
LCVA-B03	10/5/11	12	0	0	0	0	0	0	0	0	0

LCVA-B04	10/5/11	8	2	0	0	0	0	0	0	0	0
LCVA-B02	10/5/11	3	0	0	0	0	0	0	2	0	0
CC-B02	10/4/11	50	1	0	1	0	0	0	1	0	0
CC-B03	10/4/11	50	0	0	2	0	0	0	4	1	0
CC-B04	10/4/11	71	0	0	0	0	0	0	2	0	0
CC-B08	10/21/11	16	0	0	0	0	0	0	3	0	0
CCMB-B01	10/4/11	19	5	0	0	0	0	0	4	0	1
CCWF-B01	8/22/11	9	5	0	0	0	0	0	0	1	0
CC-B07	10/4/11	5	0	0	0	0	0	0	3	0	2
RFPF-B02	10/14/11	16	0	0	1	0	0	0	17	0	0
RFPF-B03	10/14/11	34	0	0	0	0	0	0	0	0	0
RFPFWF-B01	10/14/11	17	1	0	0	0	0	0	0	0	0
CCMLHB-B01	8/22/11	1	0	0	0	0	0	0	0	0	1
CCML-B02	8/22/11	11	0	0	0	0	0	0	7	1	0
CCML-B01	8/22/11	2	0	0	2	0	0	0	8	0	0
LCVA-B03	3/7/12	58	1	0	0	0	0	0	0	7	2
LCVA-B04	3/7/12	74	0	0	0	0	0	0	0	14	2
LCVA-B02	3/6/12	27	0	0	0	0	0	0	0	3	1
CC-B02	2/28/12	61	0	0	0	0	0	0	0	16	3
CC-B03	2/24/12	70	0	0	0	0	0	0	0	13	2
CC-B04	2/28/12	79	0	0	0	0	0	0	0	13	2
CC-B08	2/28/12	58	0	0	0	0	0	0	1	1	1
CCMB-B01	2/28/12	26	2	0	0	0	0	0	0	0	5
CC-B05	2/15/12	68	0	0	0	0	0	0	0	0	5
CCWF-B01	2/15/12	1	2	0	0	0	0	0	0	0	42
CC-B07	2/17/12	27	0	0	0	0	0	0	3	0	15
RFPF-B02	2/15/12	69	0	0	0	0	0	0	4	3	0
RFPF-B03	3/6/12	85	0	0	1	0	0	0	0	9	0
RFPFWF-B01	2/15/12	33	1	1	0	0	0	0	0	0	17
RFPF-B04	2/15/12	94	0	0	0	0	0	0	0	7	0
RF-B02	3/14/12	40	0	0	1	0	0	0	0	12	0
CCMLHB-B01	2/17/12	11	0	0	1	0	0	0	0	0	4
CCML-B02	2/17/12	38	0	0	0	0	0	0	2	1	17
CCML-B01	2/17/12	28	0	0	0	0	0	0	2	1	41

CC-B09	2/15/12	8	0	0	0	0	0	0	0	0	5
LCVA-B03	2/21/13	59	0	0	0	0	0	0	0	0	0
LCVA-B04	2/21/13	58	1	0	0	0	0	0	0	1	0
LCVA-B02	2/21/13	19	0	0	1	0	0	0	0	0	3
CC-B02	2/19/13	13	0	0	1	0	0	0	2	2	17
CC-B03	2/19/13	26	0	0	0	0	0	0	0	1	13
CC-B04	2/19/13	38	0	0	0	0	0	0	1	1	12
CC-B08	2/19/13	43	0	0	0	0	0	0	1	1	4
CCMB-B01	2/19/13	25	3	0	0	0	0	0	7	0	13
CC-B09	2/19/13	8	0	0	0	0	0	0	0	0	5
CC-B05	2/19/13	68	0	0	0	0	0	0	0	0	5
CCWF-B01	2/19/13	4	0	0	0	0	0	0	1	0	53
CC-B07	2/19/13	12	0	0	0	0	0	0	1	0	23
RFPF-B02	2/21/13	49	0	0	0	0	0	0	1	0	0
RFPF-B03	2/21/13	74	0	0	0	0	0	0	0	9	0
RFPFWF-B01	2/21/13	0	1	0	0	0	0	0	0	0	29
CCMLHB-B01	2/18/13	17	0	0	0	0	0	0	0	0	11
CCML-B02	2/18/13	6	0	0	0	0	0	0	0	1	7
CCML-B01	2/18/13	15	0	0	0	0	0	0	3	0	20
CC-B01	4/2/13	13	0	0	0	0	0	0	0	0	40
LCVA-B01	4/2/13	4	0	0	0	0	0	0	1	0	9
RF-B01	4/2/13	33	0	0	0	0	0	0	3	1	0
RF-B03	4/2/13	58	0	0	0	0	1	0	0	16	2
RFPF-B01	4/2/13	90	0	0	0	0	0	0	0	1	1
LCKY-B01	4/2/13	35	0	0	1	0	0	0	2	1	20
LCKY-B02	4/2/13	5	1	0	0	1	0	0	1	0	38
YC-B01	4/2/13	67	0	0	1	0	0	0	0	3	2
YC-B02	4/2/13	8	0	0	0	0	0	0	0	1	13
YC-B03	4/2/13	13	0	0	0	0	0	0	1	0	19
YC-B04	4/2/13	5	0	0	0	0	0	0	1	0	30
LCVA-B03	9/18/13	7	0	0	0	0	1	0	0	0	0
LCVA-B04	9/18/13	10	0	0	0	0	0	0	2	1	0
LCVA-B02	9/18/13	4	0	0	2	0	0	0	11	0	0
CC-B02	9/16/13	9	0	0	0	0	0	0	12	0	2

CC-B03	9/16/13	27	0	0	0	0	0	0	10	0	0
CC-B04	9/16/13	22	0	0	1	0	0	0	14	0	0
CC-B08	9/16/13	2	0	0	0	0	0	0	9	0	0
CCMB-B01	10/7/13	17	0	0	0	0	0	0	8	0	4
CC-B09	9/19/13	7	0	0	0	0	0	0	35	0	0
CC-B05	9/19/13	3	0	0	1	0	0	0	14	1	0
CCWF-B01	9/28/13	16	6	1	0	0	0	2	19	0	0
CC-B07	9/18/13	5	1	0	0	0	0	0	10	0	0
RFPF-B02	9/19/13	33	0	0	3	0	0	0	19	0	0
RFPF-B03	9/19/13	14	0	0	0	0	0	0	0	1	0
RFPFWF-B01	9/19/13	12	0	2	0	0	0	0	0	0	0
CCMLHB-B01	9/11/13	5	0	0	0	0	0	0	0	0	0
CCML-B02	9/11/13	2	0	0	0	0	0	0	6	0	0
CCML-B01	9/11/13	9	0	0	0	0	0	0	8	0	0
CC-B01	9/25/13	1	0	0	0	0	0	0	19	0	1
LCVA-B01	9/25/13	1	0	0	0	0	0	0	11	0	1
RF-B01	9/25/13	5	0	0	0	0	0	0	2	0	0
RF-B03	9/25/13	22	0	0	0	0	0	0	6	7	0
RFPF-B01	9/25/13	18	0	0	0	0	0	0	22	4	0
LCKY-B01	9/25/13	20	0	0	3	0	0	0	32	0	0
LCKY-B02	9/25/13	7	3	0	0	0	0	0	5	0	2
YC-B01	9/25/13	0	0	0	1	0	0	0	3	0	0
YC-B02	9/25/13	9	0	0	4	0	0	0	24	0	0
YC-B03	9/25/13	4	0	0	0	0	0	0	5	0	2
YC-B04	9/25/13	4	0	0	0	0	0	0	6	0	0
RFPF-B04	10/2/13	1	0	0	0	0	0	0	0	0	0
RF-B02	10/2/13	2	0	0	0	0	0	0	6	5	0
LCVA-B03	2/28/14	27	0	0	0	0	0	0	0	2	0
LCVA-B04	2/28/14	70	0	0	0	0	0	0	1	6	1
LCVA-B02	2/28/14	19	0	0	1	0	0	0	3	1	19
CC-B02	3/10/14	17	0	0	1	0	0	0	2	4	25
CC-B03	3/11/14	38	0	0	0	0	0	0	4	8	6
CC-B04	3/11/14	74	0	0	0	0	0	0	6	1	5
CC-B08	3/13/14	21	0	0	0	0	0	0	3	0	6

CCMB-B01	3/6/14	31	1	0	2	0	0	0	19	0	3
CC-B09	3/13/14	21	2	0	0	0	0	0	7	0	9
CC-B05	3/11/14	20	1	0	2	0	0	0	6	1	12
CCWF-B01	4/17/14	3	2	0	0	0	0	0	0	0	28
CC-B07	3/13/14	15	0	0	0	0	0	0	2	0	23
RFPF-B02	3/14/14	40	0	0	0	0	0	0	0	8	2
RFPF-B03	3/14/14	59	0	0	0	0	0	0	0	8	1
RFPFWF-B01	3/14/14	12	2	0	0	0	0	0	0	0	29
CCMLHB-B01	3/6/14	50	0	0	0	0	0	0	0	0	10
CCML-B02	3/10/14	86	0	0	0	0	0	0	29	1	35
CCML-B01	3/10/14	79	0	0	0	0	0	0	5	2	110
CC-B01	3/19/14	11	0	0	1	0	0	0	2	1	51
LCVA-B01	3/19/14	7	0	0	0	0	0	0	0	2	0
RF-B01	3/19/14	21	0	0	0	0	0	0	1	0	1
RF-B03	3/19/14	36	0	0	0	0	0	0	3	23	0
RFPF-B01	3/19/14	33	0	0	1	0	0	0	10	5	0
LCKY-B01	3/19/14	50	2	0	2	0	0	0	24	0	7
LCKY-B02	3/19/14	5	0	0	0	0	0	0	5	0	35
YC-B01	3/19/14	52	0	0	0	0	0	0	10	2	3
YC-B02	3/19/14	21	0	0	6	0	0	0	5	0	7
YC-B03	3/19/14	6	1	0	0	0	0	0	9	0	39
YC-B04	3/19/14	21	0	0	0	0	0	0	10	0	19

Table A-8. Family-level organism identification at biomonitoring sites III

Published ID	Date	Ephemeridae	Glossosomatidae	Goeridae	Gomphidae	Heptageniidae	Hydrobiidae	Hydropsychidae	Hydroptilidae	Isonychiidae	Leuctridae
CC-B01	9/11/12	0	0	0	0	2	0	49	0	9	0
LCVA-B01	9/11/12	0	0	0	0	0	0	6	0	0	0
RF-B01	9/10/12	0	0	0	0	0	0	52	0	0	0
RF-B03	9/10/12	0	0	0	0	0	0	63	0	0	0
RFPF-B01	9/10/12	0	0	0	0	0	0	41	1	0	0
LCKY-B01	9/11/12	1	0	0	0	0	0	65	0	0	0
LCKY-B02	9/11/12	2	0	0	0	6	0	29	0	1	0
YC-B01	9/11/12	0	0	0	0	7	0	30	0	46	0
YC-B02	9/11/12	0	0	0	0	0	0	52	0	0	0
YC-B03	9/11/12	0	1	0	2	3	0	16	1	0	1
YC-B04	9/11/12	0	0	0	0	10	0	27	0	0	0
RFPF-B02	8/23/12	0	0	0	1	0	0	53	0	0	2
RFPF-B03	8/23/12	0	0	0	2	0	0	9	0	0	0
RFPFWF-B01	8/23/12	1	0	1	17	0	0	13	0	0	42
CC-B05	8/21/12	0	0	0	1	1	0	64	0	0	2
CC-B09	8/21/12	0	0	0	0	0	0	38	0	0	1
CCWF-B01	8/21/12	0	0	0	0	0	0	63	0	0	5
RF-B02	9/10/12	0	0	0	0	0	0	61	0	0	0
RFPF-B04	9/6/12	0	0	0	0	0	0	74	0	0	0
LCVA-B02	8/28/12	0	0	0	5	0	0	158	0	3	35
LCVA-B03	8/21/12	0	0	0	5	0	0	85	1	0	1
LCVA-B04	8/28/12	0	0	0	8	0	0	193	0	0	0
CC-B02	8/28/12	0	0	0	0	0	0	68	0	0	3
CC-B03	8/21/12	0	0	0	0	0	0	71	0	0	7
CC-B04	8/28/12	0	0	0	0	0	0	61	0	0	0
CC-B08	8/28/12	0	0	0	0	0	0	72	0	0	1
CCMB-B01	8/21/12	0	0	1	2	2	0	18	0	0	35
CC-B07	8/21/12	0	0	0	0	1	0	65	0	2	8
CCMLHB-B01	8/26/12	0	0	0	0	2	0	45	0	0	47
CCML-B02	8/23/12	0	0	0	0	0	0	46	0	0	5
CCML-B01	8/23/12	0	0	0	2	1	0	41	0	0	7
LCVA-B03	10/5/11	0	0	0	2	0	0	34	0	0	0

LCVA-B04	10/5/11	0	0	0	4	0	0	51	0	0	0
LCVA-B02	10/5/11	0	0	0	0	0	0	112	0	0	0
CC-B02	10/4/11	0	0	0	0	0	0	28	0	0	1
CC-B03	10/4/11	0	0	0	0	1	0	5	0	0	0
CC-B04	10/4/11	0	0	0	0	1	0	7	0	0	0
CC-B08	10/21/11	0	0	0	0	0	0	54	0	0	0
CCMB-B01	10/4/11	0	0	0	0	10	0	21	0	0	7
CCWF-B01	8/22/11	0	0	0	0	0	0	34	0	0	20
CC-B07	10/4/11	0	0	0	0	0	0	41	0	1	0
RFPF-B02	10/14/11	0	0	0	4	0	0	51	0	0	0
RFPF-B03	10/14/11	0	0	0	0	0	0	42	0	0	0
RFPFWF-B01	10/14/11	6	0	0	12	0	0	33	0	0	13
CCMLHB-B01	8/22/11	0	0	0	2	1	0	52	0	0	66
CCML-B02	8/22/11	0	0	0	0	0	0	40	0	0	10
CCML-B01	8/22/11	0	0	0	1	2	0	24	0	0	9
LCVA-B03	3/7/12	0	0	0	0	0	0	10	0	0	0
LCVA-B04	3/7/12	0	0	0	0	0	0	10	0	0	0
LCVA-B02	3/6/12	0	0	0	0	0	0	56	0	0	0
CC-B02	2/28/12	0	0	0	0	0	0	5	0	0	0
CC-B03	2/24/12	0	0	0	0	3	0	5	0	0	0
CC-B04	2/28/12	0	0	0	0	0	0	5	0	0	0
CC-B08	2/28/12	0	0	0	0	0	0	9	0	0	1
CCMB-B01	2/28/12	2	0	0	0	10	0	3	0	0	6
CC-B05	2/15/12	0	0	0	0	0	1	8	0	0	0
CCWF-B01	2/15/12	0	0	0	0	26	0	4	0	0	0
CC-B07	2/17/12	0	0	0	0	3	0	13	0	0	0
RFPF-B02	2/15/12	0	0	0	1	0	0	21	0	0	0
RFPF-B03	3/6/12	0	0	0	0	0	0	4	0	0	0
RFPFWF-B01	2/15/12	0	0	0	7	3	0	8	0	0	2
RFPF-B04	2/15/12	0	0	0	0	0	0	4	0	0	0
RF-B02	3/14/12	0	0	0	0	0	0	33	0	0	0
CCMLHB-B01	2/17/12	0	0	0	1	1	0	13	0	0	9
CCML-B02	2/17/12	0	0	0	0	0	0	14	0	0	0
CCML-B01	2/17/12	0	0	0	0	0	0	15	0	0	0

CC-B09	2/15/12	0	0	0	0	1	0	5	0	0	0
LCVA-B03	2/21/13	0	0	0	0	0	0	29	0	0	0
LCVA-B04	2/21/13	0	0	0	0	3	1	22	0	0	0
LCVA-B02	2/21/13	0	0	0	0	2	0	31	0	0	0
CC-B02	2/19/13	0	0	0	0	0	0	36	0	1	0
CC-B03	2/19/13	0	0	0	0	0	0	13	0	0	0
CC-B04	2/19/13	0	0	0	0	1	0	21	0	0	0
CC-B08	2/19/13	0	0	0	0	0	0	19	0	0	0
CCMB-B01	2/19/13	0	0	0	0	15	0	18	0	0	0
CC-B09	2/19/13	0	0	0	0	1	0	5	0	0	0
CC-B05	2/19/13	0	0	0	0	0	1	8	0	0	0
CCWF-B01	2/19/13	0	0	0	0	14	0	10	0	0	1
CC-B07	2/19/13	0	0	0	0	0	0	11	0	0	0
RFPF-B02	2/21/13	0	0	0	0	0	0	46	0	0	0
RFPF-B03	2/21/13	0	0	0	1	0	0	6	0	0	0
RFPFWF-B01	2/21/13	0	0	0	1	16	0	17	0	0	1
CCMLHB-B01	2/18/13	0	0	0	0	1	0	29	0	0	3
CCML-B02	2/18/13	0	0	0	0	1	0	36	0	0	0
CCML-B01	2/18/13	0	0	0	0	0	0	21	0	0	0
CC-B01	4/2/13	0	0	0	1	2	0	15	0	1	1
LCVA-B01	4/2/13	0	0	0	0	0	0	2	0	0	0
RF-B01	4/2/13	0	0	0	0	0	0	56	0	5	3
RF-B03	4/2/13	0	0	0	0	0	0	20	0	0	0
RFPF-B01	4/2/13	0	0	0	0	0	0	5	0	0	0
LCKY-B01	4/2/13	0	0	0	0	13	0	19	0	0	0
LCKY-B02	4/2/13	0	0	0	0	18	0	10	0	0	0
YC-B01	4/2/13	0	0	0	0	5	0	7	0	2	2
YC-B02	4/2/13	0	0	0	0	2	0	14	0	0	0
YC-B03	4/2/13	0	0	0	0	4	0	4	0	0	8
YC-B04	4/2/13	0	0	0	0	2	0	8	0	0	1
LCVA-B03	9/18/13	0	0	0	2	0	0	72	0	0	0
LCVA-B04	9/18/13	0	0	0	1	0	0	47	0	0	3
LCVA-B02	9/18/13	0	0	0	0	0	0	37	0	0	1
CC-B02	9/16/13	0	0	0	0	0	0	56	0	1	0

CC-B03	9/16/13	1	0	0	0	5	0	41	0	0	0
CC-B04	9/16/13	0	0	0	0	1	0	45	0	0	0
CC-B08	9/16/13	0	0	0	0	0	0	85	0	0	1
CCMB-B01	10/7/13	0	0	0	2	4	0	27	0	0	6
CC-B09	9/19/13	0	0	0	1	0	0	22	0	0	0
CC-B05	9/19/13	0	0	0	0	1	0	73	0	0	0
CCWF-B01	9/28/13	0	0	0	0	0	0	33	0	0	1
CC-B07	9/18/13	0	0	0	0	0	0	75	0	2	3
RFPF-B02	9/19/13	0	0	0	0	0	0	146	0	1	0
RFPF-B03	9/19/13	0	0	0	0	0	0	54	0	0	0
RFPFWF-B01	9/19/13	2	1	0	8	0	0	129	0	0	69
CCMLHB-B01	9/11/13	0	0	1	1	2	0	61	0	0	30
CCML-B02	9/11/13	0	0	0	0	0	0	83	0	0	2
CCML-B01	9/11/13	0	0	0	1	0	0	57	0	0	7
CC-B01	9/25/13	0	0	0	1	1	0	52	0	0	0
LCVA-B01	9/25/13	0	0	0	0	0	0	9	0	0	0
RF-B01	9/25/13	0	0	0	0	0	0	86	0	4	0
RF-B03	9/25/13	0	0	0	0	0	0	72	0	0	0
RFPF-B01	9/25/13	0	0	0	1	0	0	67	0	0	0
LCKY-B01	9/25/13	0	3	0	0	0	0	34	0	0	0
LCKY-B02	9/25/13	1	0	0	1	10	0	16	0	0	3
YC-B01	9/25/13	0	0	0	2	18	0	64	0	17	0
YC-B02	9/25/13	0	1	0	0	5	0	41	0	0	1
YC-B03	9/25/13	0	1	0	0	1	0	35	1	0	1
YC-B04	9/25/13	0	0	0	0	0	0	34	0	0	0
RFPF-B04	10/2/13	0	0	0	1	0	0	72	0	0	0
RF-B02	10/2/13	0	0	0	0	0	0	93	0	0	0
LCVA-B03	2/28/14	0	0	0	0	0	0	14	0	0	1
LCVA-B04	2/28/14	0	0	0	1	0	0	10	0	0	2
LCVA-B02	2/28/14	0	0	0	0	1	0	41	0	0	0
CC-B02	3/10/14	0	0	0	0	0	0	27	0	0	3
CC-B03	3/11/14	0	0	0	0	0	0	6	0	0	2
CC-B04	3/11/14	0	0	0	0	0	0	8	0	0	0
CC-B08	3/13/14	0	0	0	0	0	0	31	0	0	0

CCMB-B01	3/6/14	0	0	0	0	29	0	7	0	0	2
CC-B09	3/13/14	0	0	0	0	2	0	19	0	0	0
CC-B05	3/11/14	0	0	0	0	0	0	17	0	1	0
CCWF-B01	4/17/14	0	0	0	0	10	0	2	0	0	1
CC-B07	3/13/14	0	0	0	0	1	0	8	0	1	0
RFPF-B02	3/14/14	0	0	0	0	0	0	39	0	0	0
RFPF-B03	3/14/14	0	0	0	0	0	0	5	0	0	0
RFPFWF-B01	3/14/14	0	0	0	0	1	0	9	0	0	8
CCMLHB-B01	3/6/14	0	0	0	0	3	0	53	0	0	77
CCML-B02	3/10/14	0	0	0	0	0	0	99	0	0	0
CCML-B01	3/10/14	0	0	0	1	0	0	62	0	0	0
CC-B01	3/19/14	0	0	0	0	0	0	27	0	3	0
LCVA-B01	3/19/14	0	0	0	0	0	0	2	0	0	0
RF-B01	3/19/14	0	0	0	0	1	0	70	0	0	0
RF-B03	3/19/14	0	0	0	0	0	0	35	0	0	0
RFPF-B01	3/19/14	0	0	0	0	0	0	49	0	0	0
LCKY-B01	3/19/14	0	0	0	0	6	0	10	0	0	0
LCKY-B02	3/19/14	0	0	0	0	27	0	8	0	0	2
YC-B01	3/19/14	0	0	0	0	5	0	24	0	3	0
YC-B02	3/19/14	0	0	0	0	4	0	52	0	0	1
YC-B03	3/19/14	0	0	0	1	4	0	11	0	0	2
YC-B04	3/19/14	0	0	0	0	2	0	18	0	0	2

Table A-9. Family-level organism identification at biomonitoring sites IV

Published ID	Date	Limnephilidae	Muscidae	Nemouridae	Oligochaeta (unknown)	Peltoperlidae	Perlidae	Perlodidae	Philopotamidae	Pleuroceridae	Polycentropodidae
CC-B01	9/11/12	0	0	0	4	0	0	0	0	0	0
LCVA-B01	9/11/12	0	0	0	0	0	0	0	0	0	0
RF-B01	9/10/12	0	0	0	8	0	0	0	1	0	0
RF-B03	9/10/12	0	0	0	6	0	0	0	1	0	0
RFPF-B01	9/10/12	0	0	0	12	0	0	0	0	0	0
LCKY-B01	9/11/12	0	0	0	1	0	0	0	0	0	0
LCKY-B02	9/11/12	0	0	0	1	0	3	0	0	0	2
YC-B01	9/11/12	0	0	0	1	0	0	0	0	0	0
YC-B02	9/11/12	0	0	0	1	0	1	0	0	0	0
YC-B03	9/11/12	0	0	0	1	0	0	0	0	0	0
YC-B04	9/11/12	0	0	0	1	0	0	0	0	0	0
RFPF-B02	8/23/12	0	0	0	14	0	0	0	3	0	0
RFPF-B03	8/23/12	0	0	1	11	0	0	0	0	0	0
RFPFWF-B01	8/23/12	0	0	1	4	0	2	2	0	0	0
CC-B05	8/21/12	0	0	0	14	0	0	0	2	0	0
CC-B09	8/21/12	0	0	0	3	0	1	0	0	0	0
CCWF-B01	8/21/12	0	0	0	7	0	5	0	0	0	0
RF-B02	9/10/12	0	0	0	7	0	0	0	0	0	0
RFPF-B04	9/6/12	0	0	0	0	0	0	0	0	0	0
LCVA-B02	8/28/12	0	0	0	27	0	1	0	2	0	1
LCVA-B03	8/21/12	0	0	0	3	0	0	0	0	0	0
LCVA-B04	8/28/12	0	0	1	4	0	0	0	0	0	0
CC-B02	8/28/12	0	1	0	5	0	0	0	0	0	0
CC-B03	8/21/12	0	0	0	8	0	0	0	0	0	0
CC-B04	8/28/12	0	0	0	4	0	0	0	0	0	0
CC-B08	8/28/12	0	0	0	3	0	0	0	0	0	0
CCMB-B01	8/21/12	0	1	0	0	0	0	0	0	0	0
CC-B07	8/21/12	0	0	2	0	0	0	0	0	0	0
CCMLHB-B01	8/26/12	0	0	2	0	0	0	0	0	0	0
CCML-B02	8/23/12	0	0	0	4	0	0	0	0	5	0
CCML-B01	8/23/12	0	0	0	1	0	0	0	0	6	0
LCVA-B03	10/5/11	0	0	0	25	0	0	0	1	0	4

LCVA-B04	10/5/11	0	0	0	7	1	0	0	0	0	2
LCVA-B02	10/5/11	0	0	0	1	0	0	0	0	0	0
CC-B02	10/4/11	0	0	0	3	0	0	0	0	0	0
CC-B03	10/4/11	0	0	0	4	0	0	2	0	0	0
CC-B04	10/4/11	0	0	0	2	0	0	0	0	0	0
CC-B08	10/21/11	0	0	0	3	0	0	0	0	0	0
CCMB-B01	10/4/11	0	0	0	0	0	2	1	1	0	0
CCWF-B01	8/22/11	0	0	0	1	1	3	0	0	0	0
CC-B07	10/4/11	0	0	0	3	0	0	0	1	0	0
RFPF-B02	10/14/11	0	0	0	14	0	0	0	6	0	0
RFPF-B03	10/14/11	0	0	0	18	0	0	0	1	0	0
RFPFWF-B01	10/14/11	4	0	0	3	0	1	0	3	0	2
CCMLHB-B01	8/22/11	0	0	0	0	0	1	0	0	0	0
CCML-B02	8/22/11	0	0	0	7	0	0	0	0	16	0
CCML-B01	8/22/11	0	0	0	7	0	0	0	0	35	0
LCVA-B03	3/7/12	0	0	6	0	0	0	0	0	0	0
LCVA-B04	3/7/12	0	0	4	0	0	0	0	0	0	0
LCVA-B02	3/6/12	0	0	3	1	0	0	7	0	0	0
CC-B02	2/28/12	0	0	1	1	0	0	1	0	0	0
CC-B03	2/24/12	0	0	0	2	0	0	0	0	0	0
CC-B04	2/28/12	0	0	1	5	0	0	1	0	0	0
CC-B08	2/28/12	0	0	7	0	0	0	0	0	0	0
CCMB-B01	2/28/12	0	0	21	1	0	1	3	0	0	2
CC-B05	2/15/12	0	0	10	0	0	0	1	0	0	0
CCWF-B01	2/15/12	0	0	4	1	0	0	9	0	0	0
CC-B07	2/17/12	0	0	13	0	0	0	1	0	0	0
RFPF-B02	2/15/12	0	0	4	1	0	0	1	5	0	0
RFPF-B03	3/6/12	0	0	2	6	0	0	0	0	0	0
RFPFWF-B01	2/15/12	0	0	21	0	0	0	1	0	0	0
RFPF-B04	2/15/12	0	0	0	4	0	0	0	0	0	0
RF-B02	3/14/12	0	0	9	6	0	0	2	0	0	0
CCMLHB-B01	2/17/12	0	0	50	0	0	1	2	0	0	1
CCML-B02	2/17/12	0	0	0	4	0	0	0	0	5	0
CCML-B01	2/17/12	0	0	0	1	0	0	0	0	0	0

CC-B09	2/15/12	0	0	6	1	0	0	3	0	0	0
LCVA-B03	2/21/13	0	0	13	3	0	0	0	0	0	0
LCVA-B04	2/21/13	0	0	7	0	0	0	2	0	0	0
LCVA-B02	2/21/13	0	0	10	0	0	0	3	0	0	0
CC-B02	2/19/13	0	0	1	0	0	0	2	0	0	0
CC-B03	2/19/13	0	0	4	1	0	0	0	0	0	0
CC-B04	2/19/13	0	0	2	1	0	0	0	0	0	0
CC-B08	2/19/13	0	0	9	0	0	0	0	1	0	0
CCMB-B01	2/19/13	0	0	2	0	1	2	2	0	0	1
CC-B09	2/19/13	0	0	6	1	0	0	3	0	0	0
CC-B05	2/19/13	0	0	10	0	0	0	1	0	0	0
CCWF-B01	2/19/13	0	0	8	1	0	1	12	0	0	0
CC-B07	2/19/13	0	0	14	0	0	0	0	1	0	0
RFPF-B02	2/21/13	0	0	1	1	0	0	0	8	0	0
RFPF-B03	2/21/13	0	0	0	12	0	0	0	0	0	0
RFPFWF-B01	2/21/13	0	0	14	1	0	1	2	1	0	0
CCMLHB-B01	2/18/13	0	0	25	0	0	1	1	0	0	6
CCML-B02	2/18/13	0	0	0	1	0	0	0	0	0	0
CCML-B01	2/18/13	0	0	0	4	0	0	0	0	0	0
CC-B01	4/2/13	0	0	1	9	0	0	2	1	0	0
LCVA-B01	4/2/13	0	0	1	0	0	0	1	0	0	0
RF-B01	4/2/13	0	0	5	3	0	0	0	0	0	0
RF-B03	4/2/13	0	0	5	5	1	0	0	0	0	0
RFPF-B01	4/2/13	0	0	0	9	0	0	1	0	0	0
LCKY-B01	4/2/13	0	0	9	2	0	0	2	0	0	0
LCKY-B02	4/2/13	0	0	4	1	0	1	5	0	0	3
YC-B01	4/2/13	0	0	0	4	0	0	0	0	0	0
YC-B02	4/2/13	0	0	1	1	1	0	1	0	0	0
YC-B03	4/2/13	0	0	0	0	0	0	3	0	0	0
YC-B04	4/2/13	0	0	5	0	0	1	1	0	0	0
LCVA-B03	9/18/13	0	0	0	6	0	0	0	2	0	0
LCVA-B04	9/18/13	0	0	0	2	0	0	0	1	0	0
LCVA-B02	9/18/13	0	0	0	4	0	0	0	0	0	0
CC-B02	9/16/13	0	0	0	1	0	0	0	0	0	0

CC-B03	9/16/13	0	0	0	4	0	0	0	0	0	0
CC-B04	9/16/13	0	0	0	7	0	0	0	0	0	0
CC-B08	9/16/13	0	0	0	1	0	0	0	0	0	0
CCMB-B01	10/7/13	0	0	0	3	0	2	4	2	0	0
CC-B09	9/19/13	0	0	0	2	0	1	0	0	0	0
CC-B05	9/19/13	0	0	0	9	1	0	0	0	0	0
CCWF-B01	9/28/13	0	0	0	6	0	3	1	0	0	0
CC-B07	9/18/13	0	0	0	2	0	0	0	0	0	0
RFPF-B02	9/19/13	0	0	0	34	0	0	0	20	0	0
RFPF-B03	9/19/13	0	0	1	26	0	0	0	12	0	0
RFPFWF-B01	9/19/13	4	0	0	0	0	5	3	2	0	0
CCMLHB-B01	9/11/13	0	0	0	0	0	2	0	2	0	1
CCML-B02	9/11/13	0	0	0	2	0	0	0	0	4	0
CCML-B01	9/11/13	0	0	0	3	0	0	0	0	2	0
CC-B01	9/25/13	0	0	0	4	0	0	0	0	0	0
LCVA-B01	9/25/13	0	0	0	0	0	0	0	0	0	0
RF-B01	9/25/13	0	0	0	2	0	0	0	0	0	0
RF-B03	9/25/13	0	0	0	5	0	0	0	0	0	0
RFPF-B01	9/25/13	0	0	0	4	0	0	0	0	0	0
LCKY-B01	9/25/13	0	0	0	1	0	0	0	0	0	0
LCKY-B02	9/25/13	0	0	0	1	0	0	0	0	0	0
YC-B01	9/25/13	0	0	0	0	0	0	0	0	0	0
YC-B02	9/25/13	0	0	0	7	0	0	0	0	0	0
YC-B03	9/25/13	0	0	0	0	0	0	0	0	0	0
YC-B04	9/25/13	0	0	0	6	0	0	0	0	0	0
RFPF-B04	10/2/13	0	0	0	10	0	0	0	1	0	0
RF-B02	10/2/13	0	0	0	2	0	0	0	0	0	0
LCVA-B03	2/28/14	0	0	60	1	0	0	0	0	0	0
LCVA-B04	2/28/14	0	0	14	3	0	0	0	0	0	1
LCVA-B02	2/28/14	0	0	13	0	0	0	7	1	0	0
CC-B02	3/10/14	0	0	0	6	0	0	0	0	0	0
CC-B03	3/11/14	0	0	0	3	0	0	0	0	0	0
CC-B04	3/11/14	0	0	1	2	0	0	0	0	0	0
CC-B08	3/13/14	0	0	37	1	0	0	0	0	0	0

CCMB-B01	3/6/14	0	0	1	1	0	0	0	0	0	0
CC-B09	3/13/14	0	0	12	1	0	0	5	0	0	0
CC-B05	3/11/14	0	0	36	5	0	0	0	0	0	1
CCWF-B01	4/17/14	0	0	49	1	0	0	4	0	0	1
CC-B07	3/13/14	0	0	25	1	0	0	0	0	0	0
RFPF-B02	3/14/14	0	0	9	4	0	0	1	3	0	0
RFPF-B03	3/14/14	0	0	11	4	0	0	0	0	0	0
RFPFWF-B01	3/14/14	0	0	38	0	0	0	2	0	0	0
CCMLHB-B01	3/6/14	0	0	73	0	0	1	8	0	0	5
CCML-B02	3/10/14	0	0	0	9	0	0	0	0	1	0
CCML-B01	3/10/14	0	0	0	7	0	0	0	0	2	0
CC-B01	3/19/14	0	0	0	4	0	0	0	0	0	0
LCVA-B01	3/19/14	0	0	10	0	0	0	2	0	0	0
RF-B01	3/19/14	0	0	1	2	0	0	1	1	0	0
RF-B03	3/19/14	0	0	2	7	0	0	1	0	0	0
RFPF-B01	3/19/14	0	0	1	8	0	0	0	0	0	0
LCKY-B01	3/19/14	0	0	2	5	0	1	1	0	0	0
LCKY-B02	3/19/14	0	0	3	0	0	1	2	0	0	0
YC-B01	3/19/14	0	0	0	2	0	0	0	0	0	0
YC-B02	3/19/14	0	0	0	0	0	0	0	0	0	0
YC-B03	3/19/14	0	0	3	0	0	1	1	0	0	0
YC-B04	3/19/14	0	0	4	1	0	0	0	0	0	0

Table A-10. Family-level organism identification at biomonitoring sites V

Published ID	Date	Psephenidae	Pteronarcyidae	Rhyacophilidae	Sialidae	Simuliidae	Stratiomyidae	Taeniopterygidae	Tipulidae	Uenoidae
CC-B01	9/11/12	4	0	0	0	15	0	0	0	0
LCVA-B01	9/11/12	0	0	0	0	4	0	0	0	0
RF-B01	9/10/12	0	0	0	0	1	0	0	7	0
RF-B03	9/10/12	0	0	0	0	4	0	0	3	0
RFPF-B01	9/10/12	0	0	0	0	6	0	0	0	0
LCKY-B01	9/11/12	1	0	0	0	1	0	0	3	0
LCKY-B02	9/11/12	12	11	5	0	4	0	0	5	0
YC-B01	9/11/12	0	0	0	0	5	0	0	0	0
YC-B02	9/11/12	10	0	0	0	1	0	0	0	0
YC-B03	9/11/12	43	1	1	0	4	0	0	0	0
YC-B04	9/11/12	27	1	2	0	12	0	0	1	0
RFPF-B02	8/23/12	1	0	0	0	0	0	0	0	0
RFPF-B03	8/23/12	1	0	0	0	0	0	0	0	0
RFPFWF-B01	8/23/12	2	0	0	0	2	0	0	1	0
CC-B05	8/21/12	1	0	0	0	2	0	0	0	0
CC-B09	8/21/12	1	0	0	0	0	0	0	0	0
CCWF-B01	8/21/12	1	0	0	0	0	0	0	1	0
RF-B02	9/10/12	0	0	0	0	3	0	0	4	0
RFPF-B04	9/6/12	0	0	0	0	0	0	0	4	0
LCVA-B02	8/28/12	2	0	0	0	3	0	0	3	0
LCVA-B03	8/21/12	0	0	1	0	0	0	0	0	0
LCVA-B04	8/28/12	0	0	1	0	0	0	0	0	0
CC-B02	8/28/12	0	0	0	3	0	10	0	0	0
CC-B03	8/21/12	0	0	0	3	0	7	0	0	0
CC-B04	8/28/12	0	0	0	0	5	13	0	1	0
CC-B08	8/28/12	0	0	0	0	0	0	0	0	0
CCMB-B01	8/21/12	2	0	0	0	0	0	0	0	0
CC-B07	8/21/12	1	0	0	0	0	0	0	0	0
CCMLHB-B01	8/26/12	1	0	4	0	0	0	0	0	0
CCML-B02	8/23/12	0	0	0	1	1	8	0	0	0
CCML-B01	8/23/12	10	0	0	2	0	6	0	0	0
LCVA-B03	10/5/11	0	0	2	0	3	0	0	23	0

LCVA-B04	10/5/11	0	0	2	0	1	0	0	28	0
LCVA-B02	10/5/11	0	0	1	0	1	0	0	1	0
CC-B02	10/4/11	0	0	0	0	2	0	0	2	0
CC-B03	10/4/11	0	0	0	0	7	0	0	3	0
CC-B04	10/4/11	0	0	0	0	1	0	0	3	0
CC-B08	10/21/11	1	0	0	0	0	0	0	3	0
CCMB-B01	10/4/11	1	0	1	0	0	0	0	2	0
CCWF-B01	8/22/11	0	0	0	0	0	0	0	7	0
CC-B07	10/4/11	0	0	0	0	1	0	0	1	0
RFPF-B02	10/14/11	0	0	0	1	1	0	0	6	0
RFPF-B03	10/14/11	0	0	0	0	0	0	0	7	0
RFPFWF-B01	10/14/11	2	0	0	2	5	0	0	7	0
CCMLHB-B01	8/22/11	0	0	0	0	0	0	0	0	0
CCML-B02	8/22/11	2	0	0	0	0	0	0	5	0
CCML-B01	8/22/11	2	0	0	0	0	0	0	3	0
LCVA-B03	3/7/12	0	0	0	1	0	0	0	0	0
LCVA-B04	3/7/12	0	0	0	0	0	0	0	0	0
LCVA-B02	3/6/12	0	0	0	0	0	0	0	0	0
CC-B02	2/28/12	0	0	0	0	0	0	0	4	0
CC-B03	2/24/12	0	0	0	1	0	0	0	4	0
CC-B04	2/28/12	0	0	0	0	0	0	0	0	0
CC-B08	2/28/12	0	0	0	1	0	0	0	0	0
CCMB-B01	2/28/12	0	0	1	0	0	0	0	3	1
CC-B05	2/15/12	0	0	0	0	0	0	1	1	0
CCWF-B01	2/15/12	0	0	0	0	0	0	0	4	1
CC-B07	2/17/12	0	0	0	1	0	0	0	0	0
RFPF-B02	2/15/12	0	0	1	0	0	0	0	0	0
RFPF-B03	3/6/12	0	0	0	0	0	0	0	2	0
RFPFWF-B01	2/15/12	0	0	1	0	0	0	0	4	0
RFPF-B04	2/15/12	0	0	1	0	0	0	0	0	0
RF-B02	3/14/12	0	0	0	0	0	0	0	3	0
CCMLHB-B01	2/17/12	1	0	0	0	0	0	0	0	0
CCML-B02	2/17/12	0	0	0	0	0	0	0	5	0
CCML-B01	2/17/12	3	0	0	0	0	0	0	3	0

CC-B09	2/15/12	0	0	0	0	0	0	0	3	0
LCVA-B03	2/21/13	0	0	4	0	0	0	0	0	1
LCVA-B04	2/21/13	0	0	1	0	0	0	1	0	0
LCVA-B02	2/21/13	0	0	2	0	0	0	2	0	0
CC-B02	2/19/13	1	0	0	0	0	0	0	3	0
CC-B03	2/19/13	0	0	0	0	0	1	0	2	0
CC-B04	2/19/13	0	0	0	0	0	0	0	2	0
CC-B08	2/19/13	0	0	0	0	0	0	0	1	0
CCMB-B01	2/19/13	1	0	0	0	1	0	0	0	3
CC-B09	2/19/13	0	0	0	0	0	0	0	3	0
CC-B05	2/19/13	0	0	0	0	0	0	1	1	0
CCWF-B01	2/19/13	0	0	0	0	0	0	0	1	0
CC-B07	2/19/13	0	0	0	0	0	0	0	1	0
RFPF-B02	2/21/13	0	0	2	0	0	0	2	0	0
RFPF-B03	2/21/13	0	0	0	0	1	0	0	5	0
RFPFWF-B01	2/21/13	0	0	6	0	0	0	0	3	0
CCMLHB-B01	2/18/13	0	0	9	0	0	0	0	0	0
CCML-B02	2/18/13	0	0	1	0	0	0	1	1	0
CCML-B01	2/18/13	2	0	0	0	0	0	0	3	0
CC-B01	4/2/13	2	0	0	0	0	0	0	1	0
LCVA-B01	4/2/13	0	0	0	0	0	0	0	0	0
RF-B01	4/2/13	0	0	2	0	0	0	0	1	0
RF-B03	4/2/13	0	0	0	0	0	0	0	1	0
RFPF-B01	4/2/13	0	0	0	0	0	0	0	1	0
LCKY-B01	4/2/13	2	1	0	0	0	0	0	0	0
LCKY-B02	4/2/13	2	14	3	1	0	0	0	2	0
YC-B01	4/2/13	0	0	0	0	0	0	0	0	0
YC-B02	4/2/13	1	0	0	0	2	0	0	0	0
YC-B03	4/2/13	3	0	1	0	2	0	0	3	0
YC-B04	4/2/13	0	1	4	0	0	0	0	1	0
LCVA-B03	9/18/13	0	0	0	0	3	0	0	13	0
LCVA-B04	9/18/13	0	0	0	0	3	0	0	35	0
LCVA-B02	9/18/13	0	0	0	0	0	0	0	1	0
CC-B02	9/16/13	0	0	2	0	0	0	0	3	0

CC-B03	9/16/13	1	0	0	1	1	0	0	2	0
CC-B04	9/16/13	0	0	0	0	0	0	0	6	0
CC-B08	9/16/13	0	0	0	0	0	0	0	1	0
CCMB-B01	10/7/13	8	0	0	0	0	0	0	2	0
CC-B09	9/19/13	4	0	2	0	0	0	0	23	0
CC-B05	9/19/13	0	0	0	0	0	0	0	2	0
CCWF-B01	9/28/13	1	0	1	0	0	0	0	14	0
CC-B07	9/18/13	2	0	0	0	0	0	0	4	0
RFPF-B02	9/19/13	0	0	3	1	24	1	0	8	0
RFPF-B03	9/19/13	0	0	0	1	2	0	0	40	0
RFPFWF-B01	9/19/13	0	0	0	1	7	0	0	14	0
CCMLHB-B01	9/11/13	2	0	0	0	0	2	0	0	0
CCML-B02	9/11/13	1	0	0	0	0	0	0	2	0
CCML-B01	9/11/13	1	0	0	1	0	0	0	3	0
CC-B01	9/25/13	2	0	0	0	2	0	0	0	0
LCVA-B01	9/25/13	0	0	1	0	2	0	0	1	0
RF-B01	9/25/13	0	0	0	0	4	0	0	0	0
RF-B03	9/25/13	0	0	0	0	0	0	0	0	0
RFPF-B01	9/25/13	0	0	0	0	0	0	0	3	0
LCKY-B01	9/25/13	1	0	0	0	0	0	0	0	0
LCKY-B02	9/25/13	2	1	6	0	1	0	0	1	0
YC-B01	9/25/13	1	0	0	0	0	0	0	0	0
YC-B02	9/25/13	6	0	0	0	0	0	0	1	0
YC-B03	9/25/13	30	0	1	0	4	0	0	1	0
YC-B04	9/25/13	5	0	2	0	17	0	0	1	0
RFPF-B04	10/2/13	0	0	0	0	1	0	0	2	0
RF-B02	10/2/13	0	0	0	0	0	0	0	0	0
LCVA-B03	2/28/14	0	0	2	0	0	0	0	1	0
LCVA-B04	2/28/14	0	0	0	0	0	0	0	1	1
LCVA-B02	2/28/14	0	0	1	0	0	0	0	0	0
CC-B02	3/10/14	1	0	0	0	0	0	0	6	0
CC-B03	3/11/14	0	0	0	1	0	0	0	8	0
CC-B04	3/11/14	0	0	0	0	0	0	0	0	0
CC-B08	3/13/14	0	0	2	0	0	0	0	0	1

CCMB-B01	3/6/14	3	0	0	0	1	0	0	0	0
CC-B09	3/13/14	1	0	1	0	0	0	0	0	0
CC-B05	3/11/14	0	0	0	1	0	0	0	0	0
CCWF-B01	4/17/14	0	0	0	0	0	0	0	1	0
CC-B07	3/13/14	0	0	2	0	0	0	0	0	0
RFPF-B02	3/14/14	0	0	1	0	0	0	0	2	0
RFPF-B03	3/14/14	0	0	0	0	0	0	0	2	0
RFPFWF-B01	3/14/14	0	0	1	0	0	0	0	1	0
CCMLHB-B01	3/6/14	2	0	20	0	1	0	0	2	3
CCML-B02	3/10/14	0	0	0	0	1	0	0	6	0
CCML-B01	3/10/14	1	0	0	0	0	0	0	5	0
CC-B01	3/19/14	0	0	2	0	0	0	0	0	0
LCVA-B01	3/19/14	0	0	0	0	2	0	0	0	0
RF-B01	3/19/14	0	0	5	0	0	0	0	1	0
RF-B03	3/19/14	0	0	1	0	0	0	0	0	0
RFPF-B01	3/19/14	0	0	0	0	0	0	0	11	0
LCKY-B01	3/19/14	2	0	2	0	0	0	1	1	0
LCKY-B02	3/19/14	0	1	2	0	0	0	3	2	2
YC-B01	3/19/14	2	0	0	0	0	0	0	0	0
YC-B02	3/19/14	2	0	1	0	0	0	0	1	0
YC-B03	3/19/14	1	0	3	0	5	0	0	0	0
YC-B04	3/19/14	1	0	2	0	0	0	0	0	0

Table A-11. EDAS-generated metrics at biomonitoring sites

Published ID	Date	HBI	VSCI	%Ephem	%PT-H	%Scrap	%Chiro	%2Dom	Richness	EPT Score	%Ephem Score	%PT-H Score	%Scrap Score	%Chiro Score	%2Dom Score	%MFBI
CCML-B01	8/22/11	4.09	59.19	8.65	8.65	45.19	1.92	56.73	63.64	36.36	14.12	24.31	87.58	98.08	62.53	86.87
CCML-B02	8/22/11	4.58	49.53	8.33	9.26	23.15	10.19	51.85	45.45	27.27	13.59	26.01	44.86	89.81	69.58	79.64
CCMLHB-B01	8/22/11	2.65	48.46	1.61	54.03	0.81	0.81	95.16	31.82	45.45	2.63	100.00	1.56	99.19	6.99	100.00
CCWF-B01	8/22/11	3.80	58.22	24.32	26.13	0.00	8.11	54.95	50.00	54.55	39.68	73.39	0.00	91.89	65.09	91.18
CC-B02	10/4/11	5.52	32.97	13.59	1.94	0.97	48.54	75.73	45.45	36.36	22.17	5.45	1.88	51.46	35.07	65.88
CC-B03	10/4/11	5.12	40.57	28.57	1.79	5.36	44.64	72.32	59.09	36.36	46.61	5.02	10.38	55.36	40.00	71.76
CC-B04	10/4/11	5.49	28.39	18.69		2.80	66.36	84.11	40.91	27.27	30.49	0.00	5.43	33.64	22.96	66.39
CC-B07	10/4/11	4.56	52.57	41.07	9.82	2.68	4.46	75.00	54.55	54.55	67.00	27.59	5.19	95.54	36.13	80.01
CCMB-B01	10/4/11	3.77	74.23	22.73	30.91	13.64	17.27	36.36	77.27	100.00	37.08	86.82	26.43	82.73	91.96	91.58
LCVA-B02	10/5/11	5.89	27.58	0.00	0.83	1.65	2.48	95.04	31.82	18.18	0.00	2.32	3.20	97.52	7.17	60.42
LCVA-B03	10/5/11	4.77	44.22	6.19	6.19	0.00	10.62	52.21	45.45	45.45	10.11	17.40	0.00	89.38	69.06	76.87
LCVA-B04	10/5/11	4.60	45.26	11.67	5.83	0.00	6.67	65.83	50.00	54.55	19.03	16.39	0.00	93.33	49.37	79.39
RFPF-B02	10/14/11	5.06	42.78	0.00	5.93	14.41	13.56	57.63	50.00	27.27	0.00	16.66	27.92	86.44	61.23	72.68
RFPF-B03	10/14/11	5.71	27.03	0.00	0.97	0.00	33.01	73.79	27.27	18.18	0.00	2.73	0.00	66.99	37.88	63.15
RFPFWF-B01	10/14/11	3.99	64.60	7.50	23.33	1.67	14.17	41.67	86.36	90.91	12.23	65.54	3.23	85.83	84.30	88.36
CC-B08	10/21/11	4.32	45.41	0.86	29.31	3.45	13.79	75.86	40.91	27.27	1.41	82.33	6.68	86.21	34.88	83.55
CC-B05	2/15/12	5.12	39.74	18.18	10.91	0.91	61.82	74.55	45.45	63.64	29.66	30.64	1.76	38.18	36.78	71.79
CC-B09	2/15/12	4.06	54.70	75.45	8.18	0.91	7.27	77.27	45.45	54.55	100.00	22.98	1.76	92.73	32.84	87.29
CCWF-B01	2/15/12	3.64	71.57	76.36	14.55	24.55	0.91	61.82	54.55	81.82	100.00	40.86	47.57	99.09	55.18	93.50
RFPF-B02	2/15/12	5.50	31.96	0.00	10.00	3.64	62.73	81.82	45.45	45.45	0.00	28.09	7.05	37.27	26.27	66.11
RFPF-B04	2/15/12	5.94	16.19	0.00	0.91	0.00	85.45	91.82	22.73	18.18	0.00	2.55	0.00	14.55	11.82	59.66
RFPFWF-B01	2/15/12	3.89	63.20	28.18	23.64	2.73	30.00	49.09	63.64	90.91	45.97	66.39	5.29	70.00	73.57	89.84
CC-B07	2/17/12	4.15	61.12	46.36	13.64	5.45	24.55	44.55	50.00	72.73	75.63	38.30	10.57	75.45	80.14	86.10
CCML-B01	2/17/12	4.78	45.84	51.82		4.55	25.45	62.73	40.91	27.27	84.53	0.00	8.81	74.55	53.86	76.77
CCML-B02	2/17/12	4.95	43.01	37.27		6.36	34.55	56.36	40.91	27.27	60.80	0.00	12.33	65.45	63.06	74.22
CCMLHB-B01	2/17/12	3.00	68.95	17.27	58.18	1.82	10.00	57.27	68.18	100.00	28.18	100.00	3.52	90.00	61.74	100.00
CC-B03	2/24/12	5.56	31.94	13.64		2.73	63.64	75.45	45.45	45.45	22.25	0.00	5.29	36.36	35.47	65.22
CC-B02	2/28/12	5.45	35.12	18.18	1.82	0.91	55.45	70.91	45.45	45.45	29.66	5.11	1.76	44.55	42.04	66.92
CC-B04	2/28/12	5.81	26.16	5.45	1.82	0.00	71.82	83.64	36.36	45.45	8.90	5.11	0.00	28.18	23.65	61.62
CC-B08	2/28/12	5.11	38.40	28.18	7.27	0.91	52.73	80.00	45.45	45.45	45.97	20.43	1.76	47.27	28.90	71.93
CCMB-B01	2/28/12	3.49	75.40	34.58	34.58	10.28	24.30	43.93	77.27	100.00	56.41	97.13	19.92	75.70	81.03	95.73
LCVA-B02	3/6/12	5.47	38.22	10.00	9.09	0.00	24.55	75.45	40.91	45.45	16.31	25.54	0.00	75.45	35.47	66.65

RFPF-B03	3/6/12	5.84	21.90	0.91	1.82	0.00	77.27	85.45	36.36	27.27	1.48	5.11	0.00	22.73	21.02	61.23
LCVA-B03	3/7/12	5.29	37.77	21.70	6.60	0.00	54.72	73.58	40.91	54.55	35.40	18.55	0.00	45.28	38.17	69.33
LCVA-B04	3/7/12	5.71	26.31	7.27	3.64	0.00	67.27	80.00	27.27	36.36	11.86	10.21	0.00	32.73	28.90	63.10
RF-B02	3/14/12	5.43	35.74	1.85	10.19	0.00	37.04	67.59	40.91	36.36	3.02	28.61	0.00	62.96	46.83	67.19
CC-B03	8/21/12	5.14	40.66	3.14	6.67	3.14	6.67	69.41	50.00	36.36	5.12	18.73	6.08	93.33	44.20	71.45
CC-B05	8/21/12	5.28	44.41	8.70	5.53	0.40	1.58	76.28	68.18	54.55	14.19	15.54	0.77	98.42	34.27	69.41
CC-B07	8/21/12	4.86	52.38	21.33	8.00	9.33	2.22	73.33	68.18	63.64	34.80	22.47	18.09	97.78	38.54	75.56
CC-B09	8/21/12	5.17	47.62	27.56	2.47	7.77	23.32	63.60	59.09	54.55	44.96	6.95	15.07	76.68	52.60	71.06
CCMB-B01	8/21/12	3.15	63.36	18.30	37.91	6.86	16.99	53.59	59.09	54.55	29.85	100.00	13.30	83.01	67.06	100.00
CCWF-B01	8/21/12	5.09	43.31	12.10	8.28	4.46	7.01	70.06	50.00	36.36	19.74	23.26	8.64	92.99	43.26	72.25
LCVA-B03	8/21/12	5.59	36.06	0.33	3.26	0.65	9.77	87.62	59.09	45.45	0.53	9.15	1.26	90.23	17.89	64.91
CCML-B01	8/23/12	4.46	57.17	13.56	5.08	29.15	2.03	47.46	63.64	45.45	22.12	14.28	56.50	97.97	75.93	81.44
CCML-B02	8/23/12	4.92	46.67	5.76	3.73	20.00	12.54	54.24	59.09	27.27	9.40	10.47	38.76	87.46	66.13	74.77
RFPF-B02	8/23/12	5.32	48.22	4.95	4.46	11.39	13.37	61.39	77.27	54.55	8.08	12.52	22.07	86.63	55.80	68.87
RFPF-B03	8/23/12	5.54	27.41	1.85	1.85	5.56	62.96	79.63	40.91	27.27	3.02	5.20	10.77	37.04	29.44	65.63
RFPFWF-B01	8/23/12	2.27	68.16	5.67	46.67	2.00	10.33	58.00	90.91	90.91	9.24	100.00	3.88	89.67	60.69	100.00
CCMLHB-B01	8/26/12	2.99	59.79	2.38	48.64	2.72	4.42	83.67	77.27	72.73	3.88	100.00	5.27	95.58	23.59	100.00
CC-B02	8/28/12	5.62	39.19	5.26	4.51	2.63	9.02	74.81	59.09	36.36	8.59	12.67	5.10	90.98	36.40	64.37
CC-B04	8/28/12	5.51	38.90	7.64	0.33	5.32	9.63	62.79	50.00	27.27	12.47	0.93	10.30	90.37	53.77	66.10
CC-B08	8/28/12	5.50	40.14	10.54	1.28	8.63	7.99	76.04	54.55	36.36	17.20	3.59	16.72	92.01	34.63	66.10
LCVA-B02	8/28/12	5.08	54.17	9.60	12.07	1.24	3.72	59.75	90.91	63.64	15.66	33.92	2.40	96.28	58.16	72.39
LCVA-B04	8/28/12	5.76	29.58	0.00	0.84	0.00	9.62	90.79	40.91	27.27	0.00	2.35	0.00	90.38	13.30	62.39
RFPF-B04	9/6/12	5.66	30.20	0.88		5.26	24.56	78.07	40.91	18.18	1.43	0.00	10.20	75.44	31.69	63.77
RF-B01	9/10/12	5.36	37.66	13.27	0.88	1.77	20.35	66.37	50.00	27.27	21.65	2.49	3.43	79.65	48.60	68.21
RF-B02	9/10/12	5.84	26.02	0.55		0.00	26.52	90.61	40.91	18.18	0.90	0.00	0.00	73.48	13.57	61.15
RF-B03	9/10/12	5.79	31.08	0.00	1.82	1.82	25.45	81.82	50.00	27.27	0.00	5.11	3.52	74.55	26.27	61.93
RFPF-B01	9/10/12	5.87	29.32	2.75	0.92	3.67	38.53	76.15	36.36	27.27	4.49	2.58	7.11	61.47	34.47	60.79
CC-B01	9/11/12	4.97	48.03	29.17		13.33	1.67	60.83	45.45	36.36	47.58	0.00	25.84	98.33	56.60	74.04
LCKY-B01	9/11/12	5.41	40.73	12.40		10.74	15.70	67.77	59.09	27.27	20.22	0.00	20.82	84.30	46.58	67.52
LCKY-B02	9/11/12	3.92	73.99	9.73	20.35	23.89	4.42	36.28	95.45	100.00	15.88	57.17	46.31	95.58	92.08	89.42
LCVA-B01	9/11/12	7.30	26.28	13.16		0.00	0.00	91.23	18.18	18.18	21.46	0.00	0.00	100.00	12.68	39.73
YC-B01	9/11/12	3.88	53.66	62.28		6.14	2.63	66.67	45.45	36.36	100.00	0.00	11.90	97.37	48.17	90.06
YC-B02	9/11/12	4.95	48.08	16.52	0.87	27.83	1.74	64.35	50.00	27.27	26.95	2.44	53.93	98.26	51.52	74.30
YC-B03	9/11/12	4.24	65.92	18.75	5.36	44.64	9.82	54.46	72.73	81.82	30.59	15.05	86.52	90.18	65.80	84.66

YC-B04	9/11/12	4.69	59.74	17.12	2.70	44.14	4.50	48.65	63.64	45.45	27.92	7.59	85.55	95.50	74.21	78.07
CCML-B01	2/18/13	4.65	65.94	56.36	0.00	4.55	13.64	57.27	100.00	100.00	91.95	0.00	8.81	86.36	61.74	78.66
CCML-B02	2/18/13	4.72	62.17	57.27	1.82	0.91	5.45	82.73	100.00	100.00	93.43	5.11	1.76	94.55	24.96	77.58
CCMLHB-B01	2/18/13	3.90	72.22	17.27	40.91	0.91	15.45	49.09	100.00	100.00	28.18	100.00	1.76	84.55	73.57	89.71
CC-B02	2/19/13	4.85	63.22	43.64	2.73	2.73	11.82	60.00	100.00	100.00	71.18	7.66	5.29	88.18	57.80	75.67
CC-B03	2/19/13	4.72	62.76	55.45	3.64	0.00	23.64	67.27	100.00	100.00	90.46	10.21	0.00	76.36	47.29	77.71
CC-B04	2/19/13	5.06	58.22	39.09	1.82	1.82	34.55	61.82	100.00	100.00	63.77	5.11	3.52	65.45	55.18	72.72
CC-B05	2/19/13	5.50	39.76	18.18	10.91	0.91	61.82	74.55	100.00	100.00	29.66	30.64	1.76	38.18	36.78	71.79
CC-B07	2/19/13	3.71	74.40	63.64	13.64	0.91	10.91	49.09	100.00	100.00	100.00	38.30	1.76	89.09	73.57	92.51
CC-B08	2/19/13	4.87	58.49	30.91	9.09	0.91	39.09	62.73	100.00	100.00	50.42	25.54	1.76	60.91	53.86	75.40
CC-B09	2/19/13	4.26	53.37	75.45	8.18	0.91	7.27	77.27	100.00	100.00	100.00	22.98	1.76	92.73	32.84	87.29
CCMB-B01	2/19/13	4.35	74.41	40.00	12.73	23.64	22.73	39.09	100.00	100.00	65.25	35.75	45.81	77.27	88.02	83.16
CCWF-B01	2/19/13	3.64	79.52	76.36	14.55	24.55	0.91	61.82	100.00	100.00	100.00	40.86	47.57	99.09	55.18	93.50
LCVA-B02	2/21/13	4.61	65.78	37.27	15.45	1.82	17.27	60.91	100.00	100.00	60.80	43.41	3.52	82.73	56.49	79.28
LCVA-B03	2/21/13	5.21	49.36	0.91	16.36	0.91	53.64	80.00	100.00	100.00	1.48	45.97	1.76	46.36	28.90	70.37
LCVA-B04	2/21/13	5.18	52.18	13.64	10.91	3.64	52.73	72.73	100.00	100.00	22.25	30.64	7.05	47.27	39.41	70.86
RFPF-B02	2/21/13	5.54	46.96	0.00	11.82	0.91	44.55	86.36	100.00	100.00	0.00	33.20	1.76	55.45	19.71	65.57
RFPF-B03	2/21/13	5.79	40.78	0.00	0.00	0.00	67.27	78.18	100.00	100.00	0.00	0.00	0.00	32.73	31.53	61.97
RFPFWF-B01	2/21/13	3.91	80.43	50.00	23.64	14.55	6.36	41.82	100.00	100.00	81.57	66.39	28.19	93.64	84.08	89.58
CC-B01	4/2/13	4.38	62.45	58.77	4.39	3.51	11.40	56.14	68.18	81.82	95.88	12.32	6.80	88.60	63.38	82.63
LCKY-B01	4/2/13	4.78	57.46	33.04	10.71	15.18	31.25	49.11	63.64	63.64	53.89	30.10	29.42	68.75	73.54	76.74
LCKY-B02	4/2/13	3.43	81.61	52.14	26.50	17.95	4.27	47.86	90.91	100.00	85.05	74.43	34.78	95.73	75.34	96.60
LCVA-B01	4/2/13	6.73	37.08	25.83	1.67	0.83	3.33	85.00	36.36	45.45	42.14	4.68	1.61	96.67	21.68	48.04
RF-B01	4/2/13	5.23	40.22	7.76	8.62	2.59	28.45	76.72	50.00	54.55	12.66	24.22	5.01	71.55	33.64	70.15
RF-B03	4/2/13	5.69	31.61	1.82	5.45	0.00	52.73	70.91	45.45	36.36	2.97	15.32	0.00	47.27	42.04	63.45
RFPF-B01	4/2/13	5.75	24.61	8.55	0.85	0.00	76.92	84.62	36.36	36.36	13.94	2.40	0.00	23.08	22.23	62.50
YC-B01	4/2/13	5.30	40.42	24.56	1.75	4.39	58.77	74.56	59.09	63.64	40.07	4.93	8.50	41.23	36.76	69.12
YC-B02	4/2/13	4.39	55.73	73.45	2.65	2.65	7.08	72.57	54.55	63.64	100.00	7.46	5.15	92.92	39.64	82.46
YC-B03	4/2/13	3.88	65.42	63.96	10.81	7.21	11.71	58.56	68.18	72.73	100.00	30.37	13.97	88.29	59.89	89.96
YC-B04	4/2/13	3.86	64.53	74.78	11.30	2.61	4.35	73.04	63.64	90.91	100.00	31.75	5.06	95.65	38.95	90.28
CCML-B01	9/11/13	4.93	44.71	14.55	6.36	10.00	8.18	66.36	54.55	27.27	23.73	17.88	19.38	91.82	48.61	74.49
CCML-B02	9/11/13	5.48	36.77	7.27	1.82	10.00	1.82	82.73	40.91	27.27	11.86	5.11	19.38	98.18	24.96	66.45
CCMLHB-B01	9/11/13	4.10	54.73	2.73	32.73	3.64	4.55	82.73	54.55	72.73	4.45	91.93	7.05	95.45	24.96	86.76
CC-B02	9/16/13	5.07	44.54	24.55	1.82	10.91	8.18	72.73	40.91	45.45	40.04	5.11	21.14	91.82	39.41	72.45

CC-B03	9/16/13	5.16	43.46	13.64		14.55	24.55	61.82	59.09	36.36	22.25	0.00	28.19	75.45	55.18	71.17
CC-B04	9/16/13	5.23	40.25	12.73		13.64	20.00	60.91	40.91	27.27	20.76	0.00	26.43	80.00	56.49	70.10
CC-B08	9/16/13	5.55	34.48	10.00	0.91	8.18	1.82	87.27	31.82	27.27	16.31	2.55	15.86	98.18	18.39	65.43
CC-B07	9/18/13	5.27	41.50	7.27	3.64	10.91	4.55	77.27	45.45	45.45	11.86	10.21	21.14	95.45	32.84	69.58
LCVA-B02	9/18/13	6.58	32.57	0.00	0.91	10.00	3.64	77.27	40.91	18.18	0.00	2.55	19.38	96.36	32.84	50.36
LCVA-B03	9/18/13	5.44	31.83	0.00	1.87	0.00	6.54	79.44	40.91	18.18	0.00	5.25	0.00	93.46	29.71	67.12
LCVA-B04	9/18/13	4.72	37.61	0.00	3.64	1.82	9.09	74.55	54.55	27.27	0.00	10.21	3.52	90.91	36.78	77.61
CC-B05	9/19/13	5.50	39.76	2.73	0.91	13.64	2.73	79.09	54.55	36.36	4.45	2.55	26.43	97.27	30.22	66.25
CC-B09	9/19/13	4.26	53.37	8.18	2.73	35.45	6.36	52.73	54.55	36.36	13.35	7.66	68.71	93.64	68.31	84.42
RFPF-B02	9/19/13	5.42	44.96	1.67	7.69	6.35	11.04	60.20	63.64	45.45	2.73	21.61	12.31	88.96	57.51	67.43
RFPF-B03	9/19/13	4.71	40.12	0.00	8.50	0.00	9.15	61.44	45.45	27.27	0.00	23.87	0.00	90.85	55.73	77.81
RFPFWF-B01	9/19/13	3.63	63.86	4.14	35.86	0.34	4.14	68.28	77.27	90.91	6.75	100.00	0.67	95.86	45.84	93.61
CC-B01	9/25/13	5.04	47.52	23.85		20.18	0.92	69.72	50.00	36.36	38.91	0.00	39.12	99.08	43.75	72.97
LCKY-B01	9/25/13	4.92	46.56	9.35	2.80	33.64	18.69	61.68	45.45	27.27	15.25	7.88	65.20	81.31	55.37	74.78
LCKY-B02	9/25/13	3.47	69.31	28.00	13.00	17.00	7.00	40.00	81.82	81.82	45.68	36.52	32.95	93.00	86.71	95.96
LCVA-B01	9/25/13	6.55	39.12	17.59	0.93	10.19	0.93	75.93	40.91	36.36	28.70	2.60	19.74	99.07	34.79	50.79
RF-B01	9/25/13	5.58	34.33	15.25		1.69	4.24	84.75	36.36	27.27	24.88	0.00	3.28	95.76	22.04	65.04
RF-B03	9/25/13	5.88	26.51	0.00		5.31	19.47	83.19	27.27	9.09	0.00	0.00	10.29	80.53	24.30	60.59
RFPF-B01	9/25/13	5.45	36.47	0.81		17.89	14.63	72.36	45.45	18.18	1.33	0.00	34.66	85.37	39.95	66.86
YC-B01	9/25/13	4.77	48.82	38.26		19.13	0.00	71.30	36.36	36.36	62.42	0.00	37.07	100.00	41.47	76.85
YC-B02	9/25/13	4.86	55.32	17.09	1.71	30.77	7.69	55.56	63.64	54.55	27.89	4.80	59.63	92.31	64.23	75.53
YC-B03	9/25/13	4.65	60.60	22.73	3.64	34.55	3.64	59.09	63.64	72.73	37.08	10.21	66.95	96.36	59.12	78.74
YC-B04	9/25/13	4.78	47.60	39.06	1.56	8.59	3.13	65.63	45.45	27.27	63.72	4.39	16.65	96.88	49.67	76.78
CCWF-B01	9/28/13	4.55	54.37	0.00	10.91	18.18	14.55	47.27	72.73	54.55	0.00	30.64	35.24	85.45	76.20	80.18
RF-B02	10/2/13	5.88	27.38	0.00		5.50	1.83	90.83	27.27	9.09	0.00	0.00	10.67	98.17	13.26	60.61
RFPF-B04	10/2/13	5.75	29.73	0.00	1.10	0.00	1.10	90.11	40.91	18.18	0.00	3.09	0.00	98.90	14.29	62.45
CCMB-B01	10/7/13	4.19	66.56	15.45	20.00	18.18	15.45	40.00	77.27	81.82	25.21	56.18	35.24	84.55	86.71	85.49
LCVA-B02	2/28/14	4.69	58.88	18.27	22.91	3.10	18.27	51.39	68.18	72.73	29.80	64.35	6.00	81.73	70.24	78.02
LCVA-B03	2/28/14	3.67	54.08	2.00	55.67	0.00	26.33	78.67	59.09	72.73	3.26	100.00	0.00	73.67	30.83	93.05
LCVA-B04	2/28/14	5.20	45.38	1.95	16.23	1.30	63.96	77.60	90.91	81.82	3.18	45.60	2.52	36.04	32.37	70.64
CCMB-B01	3/6/14	3.96	78.84	36.18	13.49	43.42	21.38	43.09	100.00	100.00	59.03	37.88	84.15	78.62	82.24	88.77
CCMLHB-B01	3/6/14	2.87	68.39	6.05	59.55	2.55	15.92	47.77	72.73	100.00	9.87	100.00	4.94	84.08	75.48	100.00
CC-B02	3/10/14	4.90	52.60	33.56	3.42	2.74	20.89	48.63	68.18	54.55	54.75	9.62	5.31	79.11	74.23	75.04
CCML-B01	3/10/14	4.93	46.93	45.90	0.33	2.62	25.90	61.97	54.55	36.36	74.88	0.92	5.08	74.10	54.96	74.62

CCML-B02	3/10/14	5.27	40.31	21.55		10.10	28.96	62.29	45.45	27.27	35.15	0.00	19.58	71.04	54.49	69.50
CC-B03	3/11/14	4.80	50.71	38.89	1.39	6.25	33.33	64.58	68.18	63.64	63.44	3.90	12.11	66.67	51.18	76.54
CC-B04	3/11/14	5.49	37.32	14.95	1.00	5.32	64.45	74.75	68.18	54.55	24.39	2.80	10.30	35.55	36.49	66.30
CC-B05	3/11/14	3.83	68.49	18.44	38.30	4.61	19.15	55.32	81.82	90.91	30.08	100.00	8.93	80.85	64.57	90.79
CC-B07	3/13/14	3.84	67.97	49.51	22.15	5.54	14.33	43.32	59.09	72.73	80.77	62.22	10.73	85.67	81.90	90.64
CC-B08	3/13/14	4.12	58.25	7.49	40.39	2.93	19.54	65.80	59.09	72.73	12.22	100.00	5.68	80.46	49.42	86.43
CC-B09	3/13/14	3.98	69.88	41.26	21.33	6.29	15.38	39.51	68.18	90.91	67.31	59.91	12.20	84.62	87.41	88.54
RFPF-B02	3/14/14	5.19	44.65	2.71	14.24	2.03	34.24	68.81	63.64	63.64	4.42	39.99	3.94	65.76	45.07	70.74
RFPF-B03	3/14/14	5.30	31.41	3.26	11.96	0.00	64.13	76.09	36.36	36.36	5.32	33.59	0.00	35.87	34.56	69.18
RFPFWF-B01	3/14/14	3.06	74.45	35.99	46.82	4.46	9.24	61.46	81.82	100.00	58.71	100.00	8.64	90.76	55.69	100.00
CC-B01	3/19/14	4.58	51.53	58.62	1.72	1.72	9.48	67.24	45.45	45.45	95.63	4.84	3.34	90.52	47.34	79.70
LCKY-B01	3/19/14	4.85	55.70	12.71	7.63	27.12	42.37	62.71	72.73	90.91	20.74	21.42	52.56	57.63	53.88	75.74
LCKY-B02	3/19/14	3.80	79.10	64.15	15.09	32.08	4.72	58.49	81.82	100.00	100.00	42.40	62.16	95.28	59.98	91.15
LCVA-B01	3/19/14	6.95	34.15	3.67	11.01	0.00	6.42	82.57	36.36	36.36	5.99	30.92	0.00	93.58	25.19	44.79
RF-B01	3/19/14	5.44	41.89	4.59	7.34	1.83	19.27	83.49	59.09	72.73	7.48	20.62	3.56	80.73	23.86	67.07
RF-B03	3/19/14	5.76	33.38	0.00	3.70	2.78	33.33	65.74	36.36	36.36	0.00	10.40	5.38	66.67	49.51	62.32
RFPF-B01	3/19/14	5.42	34.92	3.28	0.82	8.20	27.05	67.21	40.91	27.27	5.35	2.30	15.89	72.95	47.38	67.34
YC-B01	3/19/14	5.30	41.15	21.37		14.53	44.44	64.96	45.45	45.45	34.86	0.00	28.16	55.56	50.64	69.05
YC-B02	3/19/14	5.32	45.20	18.18	1.82	10.00	19.09	66.36	54.55	54.55	29.66	5.11	19.38	80.91	48.61	68.85
YC-B03	3/19/14	4.08	69.60	60.87	9.57	12.17	5.22	57.39	72.73	90.91	99.30	26.87	23.59	94.78	61.57	87.08
YC-B04	3/19/14	4.46	59.55	46.90	7.08	11.50	18.58	46.90	54.55	63.64	76.51	19.89	22.30	81.42	76.73	81.41
CCWF-B01	4/17/14	2.86	74.55	40.47	53.85	11.71	3.01	70.57	68.18	100.00	66.02	100.00	22.69	96.99	42.53	100.00