AN ALTERNATIVE COMPLIANCE FRAMEWORK FOR STORMWATER FOR STORMWATER MANAGEMENT IN THE CENTRAL COAST REGION

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“A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise”. Aldo Leopold (1887-1948)

An alternative compliance framework for stormwater management in the Central Coast Region

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Executive Summary

Urbanization modifies watershed hydrology, increases stormwater runoff, and impacts the quality of receiving waters. The Central Coast Regional Water Quality Control Board (CCRWQCB) will be requiring hydromodification control and Low Impact Development (LID) for certain new development and redevelopment projects as part of their "Post-construction Stormwater Management Requirements for Development Projects in the Central Coast Region" (PCRs) for Municipal Phase I and II Stormwater NPDES permits. Compliance with PCRs revolves around the use of structural and non-structural LID stormwater control measures (SCMs) and numerical performance-based criteria. An alternative compliance (AC) approach provides off-site compliance options when on-site compliance may be infeasible. Flexibility in meeting compliance is often desired by a municipality in order to have a venue to allow developers proposing a development project to pay the municipality a sum of money to implement stormwater controls at a different location within the watershed, and to support the optimization of stormwater management, community development, and natural resource protection within a watershed. Municipalities in the Central Coast Region should develop AC programs as PCRs may necessitate the need for off-site mitigation to achieve compliance.

The purpose of this report is to assist municipalities in meeting state and federal hydromodification and water quality control requirements by synthesizing the legal, environmental, technical and socioeconomic considerations of alternative compliance and developing a framework to create AC programs. Additionally, the report summarizes findings from a planning level exercise conducted with the City of Watsonville to evaluate the feasibility aspects of alternative compliance.

Of the various AC funding approaches investigated in the report, fee-in-lieu appears to be the best approach for municipalities to balance benefit and risk tradeoffs. It is recommended that municipalities in the Central Coast Region use fee-in-lieu payment as the main funding mechanism for their AC programs with runoff reduction as their trading currency. A common perception of AC programs is that they favor the economic interests of developers over environmental protection however this report found fee-in-lieu programs can serve diverse community interests with multiple environmental and economic benefits. All off-site mitigation projects may provide some degree of benefit but they also present a risk to the public due to the on-site impact left unmitigated. For municipalities, the overarching tradeoffs of fee-in-lieu programs are: (1) flexibility from performance-based requirements *versus* increased risks and responsibilities; (2) efficiency and effectiveness gains *versus* equity concerns; and (3) cost of on-site compliance *versus* cost of off-site mitigation and transaction costs.

The case study piloted methodology for fee-in-lieu estimation and off-site location identification and results indicate some development projects may need off-site compliance options to meet proposed PCRs however only small amounts of runoff mitigation may be necessary. Fee-in-lieu rates were estimated using planning level SCM life cycle costs such as construction, pre-construction, and annual operation and maintenance costs. The broad range of costs across different fee-in-lieu options highlighted the difficulty of choosing a single fee-in-lieu rate and the risk of underfunding off-site compliance projects.

Design challenges for AC programs include optimizing flexibility and reducing uncertainty and transaction costs. To overcome these challenges and maximize benefits, firstly it is recommended municipalities strive to identify off-site locations prior to demand and integrate community objectives for green infrastructure and watershed scale protection and enhancement. Secondly, it is recommended municipalities develop prioritization and weighting criteria for off-site projects. Projects on public land should be given highest priority, with application in public ROWs considered the best in terms of feasibility, risk and benefit. Thirdly, it is recommended municipalities build safeguards into AC programs to reduce environmental and socioeconomic risks. Safeguards include:

- more stringent requirements for on-site locations in sensitive areas (e.g., higher trading ratios) to avoid 'hot spot' development;
- off-site projects use SCMs consistent with their location's Watershed Management Zones;
- development of trading ratios to create net environmental benefits;
- only allow use of SCMs with known costs;
- use an annual fee schedule rather than one-time fee payment;
- design Urban Sustainable Area (USA) restrictions to encourage smart growth (e.g., infill and high density development) in downtown areas but avoid allowing all smart growth projects to be designated USA or restricting USAs to only downtown areas.

Further studies at the regional level are recommended to assist municipalities develop their fee-in-lieu program. Topics include:

- examples of legal agreements between AC parties (e.g., municipality and developer, municipality and other municipalities);
- better cost information broken out into planning, design, construction, and operation and maintenance;
- better cost data for different AC scenarios (e.g., for new development, redevelopment, different soils);
- better understanding of methodologies to determine cost-benefits of out-of-kind mitigation;
- metrics suitable to the Central Coast Region, to translate mitigation units into common trading currency (e.g., X amount of stormwater volume equals Y amount of riparian restoration);
- better understanding of methodologies to develop trading ratios;
- better understanding of how to assess cumulative risks of unmitigated runoff at parcel scale and watershed scale.

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Alternative Compliance (AC): Also known as off-site mitigation, AC is a term used to describe a provision offered by municipalities as an alternative to the uniform application of numeric performance criteria which allows developers to meet new and redevelopment requirements for stormwater control *off-site* of a project.

Biofiltration: A Stormwater Control Measure designed to detain and filter runoff through soil media and plant roots, and release the treated runoff to the storm drain system. Biotreatment systems include an underdrain (CCPCR 2012).

Bioretention: A Stormwater Control Measure designed to retain runoff using vegetated depressions and soils engineered to collect, store, treat, and infiltrate runoff. Bioretention designs do not include underdrains (CCPCR 2012).

Evapotranspiration: The loss of water to the atmosphere by the combined processes of evaporation from soil and plant surfaces and transpiration from plant tissues (CCPCR 2012).

Fee-in-lieu: An alternative compliance funding mechanism where the developer or property owner pays a fee, the monetary amount necessary for the municipality to provide a proportional share of runoff treatment off-site. Municipalities may use fees for site identification, design, construction, and operation and maintenance of off-site projects.

Hydromodification: Alterations of the hydrologic regime as a result of land-use changes (US EPA 1997). Hydromodification can be any activity that increases the velocity, volume, and often the timing of runoff such as development of impervious surfaces and removal of vegetation.

Impervious Surface: A hard, non-vegetated surface area that prevents or limits the entry of water into the soil as would occur under natural conditions prior to development. Common impervious surfaces include roof tops, parking lots, or other surfaces which similarly impede the natural infiltration of stormwater (CCPCR 2012).

In-Kind Mitigation: A mitigation treatment which can be directly linked the trading currency.

Low Impact Development: A stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation, and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design (CCPCR 2012).

Maximum Extent Practical (MEP): The statutory standard for implementation of stormwater control measures for municipal stormwater permits within the National Pollutant Discharge Elimination System (NPDES) program.

New Development: Land disturbing activities that include the construction or installation of buildings, roads, driveways and other impervious surfaces. Development projects with preexisting impervious surfaces are not considered new development (CCPCR 2012).

Off-Site Project: A mitigation activity installed at an off-site location designed to achieve stormwater management compliance requirements an on-site project is unable to achieve at its on-site location.

On-Site Project: Also known as a regulated project, an on-site project is a new development or redevelopment project that is subject to post-construction stormwater management requirements.

Out-Of-Kind Mitigation: A mitigation treatment which is not directly linked the trading currency.

Percentile Rainfall Event: A percentile rainfall event represents a rainfall amount which a certain percent of all rainfall events for the period of record do not exceed. For example, the 95th percentile rainfall event is defined as the measured rainfall depth accumulated over a 24-hour period, for the period of record, which ranks as the 95th percentile rainfall depth based on the range of all daily event occurrences during this period (CCPCR 2012).

Permeable or Pervious Surface: A surface that allows varying amounts of stormwater to infiltrate into the ground. Examples include native vegetation areas, landscape areas, and permeable pavements designed to infiltrate (CCPCR 2012).

Post-Construction Requirements: Stormwater management regulations for new development and redevelopment projects, also known as compliance requirements or PCRs, which aim to ensure that the NPDES municipal Permittee is reducing pollutant discharges to the Maximum Extent Practicable and preventing stormwater discharges from causing or contributing to a violation of receiving water quality standards. The Post-Construction Requirements emphasize protecting and, where degraded, restoring key watershed processes to create and sustain linkages between hydrology, channel geomorphology, and biological health necessary for healthy watersheds (CCPCR 2012).

Rainwater Harvest: Capture and storage of rainwater or stormwater runoff for later use, such as irrigation or domestic use (CCPCR 2012).

Receiving Waters: Bodies of water, surface water systems or groundwater that receive surface water runoff through a point source, sheet flow or infiltration (CCPCR 2012).

Redevelopment: On a site that has already been developed, construction or installation of a building or other structure subject to the Permittee's planning and building authority including: 1) the creation or addition of impervious surfaces; 2) the expansion of a building footprint or addition or replacement of a structure; or 3) structural development including construction, installation or expansion of a building or other structure (CCPCR 2012).

Stormwater Control Measures (SCMs): Stormwater management measures integrated into project designs that emphasize protection of watershed processes through replication of pre-development runoff patterns (rate, volume, duration). Physical control measures include bioretention/rain gardens, permeable pavements, and vegetated roofs. Design control measures include conserving and protecting the function of existing natural areas, maintaining or creating riparian buffers, directing runoff from impervious surfaces toward pervious areas, and distributing physical control measures to maximize infiltration, filtration, storage, evaporation, and transpiration of stormwater before it becomes runoff (CCPCR 2012).

Stormwater Runoff: Rainfall that "runs off" across the land or impervious surfaces instead of seeping into the ground. Runoff may accumulate debris, chemicals, sediment or other pollutants that could adversely affect water quality if it flows untreated into the nearest stream, creek, river, lake or ocean.

Stormwater Credit: An amount of runoff reduction volume per unit time (e.g., gallons per year) assigned to a particular stormwater control measure at an off-site location based on scientific information, literature review, and/or modeling. Credits are tradable units which may be used to mitigate impacts at on-site locations.

Trading Currency: The unit of trade exchanged between parties in an alternative compliance agreement.

Trading Ratio: A mitigation requirement that credits be exchanged (i.e., traded between off-site and on-site projects) other than a one-to-one ratio. Trading ratios weight off-site projects to account for spatial and temporal differences and reduce uncertainties regarding mitigation equivalency between the impacted site and the mitigation activity.

Transaction Costs: The administrative costs incurred by municipalities and developers to administer and/or participate in AC programs. Transaction costs incurred by parties involved in AC agreements may include site identification, negotiation of agreements, and off-site project monitoring.

Watershed Management Zones (WMZs): Urban areas in the Central Coast Region are categorized into ten WMZs based on common key watershed processes (e.g., infiltration, groundwater recharge) and receiving water type (e.g., creek, marine nearshore waters). Each WMZ is aligned with specific post-construction stormwater management and numeric performance requirements to address the impacts of development on those watershed processes and beneficial uses (CCPCR 2012).

Watershed Processes: Watershed processes identified in the Central Coast Region include infiltration and groundwater recharge, evapotranspiration, delivery of sediment and organic matter to receiving waters, and chemical and biological transformations.

1.0 Introduction

1.1 Background

Urbanization results in increased impervious surfaces such as roads, parking lots and rooftops and decreased amount of pervious surfaces associated with pre-development conditions such as forests and grasslands. Urbanization also brings drainage infrastructure such as gutters, pipes and concrete channels to manage the increased runoff and reduce flood risk. The combination of increasing imperviousness, efficiency of water conveyance and decreased pervious coverage disrupts the hydrology of a watershed (Carter 1961), which can result in adverse impacts to receiving waters. The term "hydromodification" describes alterations of the hydrologic regime as a result of land-use changes (US EPA 1997). Large volumes of rapidly moving stormwater increase peak flows in streams during storm events and cause bank scouring and erosion, and increased imperviousness reduces groundwater recharge and its contribution to stream flow (Booth et al. 2002; Hammer 1972; Leopold 1968). Urban stormwater also picks up pollutants, such as bacteria, heavy metals, nutrients, pesticides and sediment from a variety of sources including lawns, septic tanks, roads and industry, which can degrade drinking water sources and cause fishing and swimming advisories (Griffin et al. 1980; May et al. 1997).

Urban stormwater has traditionally been managed through an end-of-pipe approach, relying on centralized collection, detention and conveyance to receiving waterbodies (Keeley 2007). Low Impact Development is a relatively new stormwater management approach in which structural and non-structural control measures are used to mimic the functions of the natural environment and decrease the environmental impacts associated with development (Poff et al. 1997; Walsh et al. 2005; Roy et al. 2008). Structural LID control measures are designed to capture or temporarily retain stormwater (e.g. rainwater harvesting, rain barrels), infiltrate stormwater (e.g. biofiltration swales, pervious pavement), and promote evapotranspiration (e.g. green roofs, rain gardens) (US EPA 2007a). Non-structural LID control measures include site and road design to minimize impervious surfaces, maintain vegetated areas and minimize site disturbance (MRUAP 2011). By capturing stormwater at or near the source of runoff, LID control measures could reduce flood frequency (Guo 2006). Additionally, implementation of LID control measures could serve to restore the critical components of natural flow regimes of river ecosystems, including the magnitude, duration, timing, rate of change and frequency of low and high flow conditions (Poff et al.1997). LID control measures not only mimic the pre-development hydrology but also decrease the pollutant load via filtration and biodegradation and therefore have the potential to remediate both water quantity and water quality issues (Chester and Gibbons 1996; Hatt et al. 2004).

Municipalities are increasingly required by state and federal law to regulate stormwater to address the adverse impacts of the urbanized environment including post-construction runoff associated with new and redevelopment. LID and hydromodification control requirements are designed to mimic the pre-development runoff characteristics of a site and aim to address cumulative impacts of site-scale development, encourage watershed-scale restoration/protection of pre-development hydrological processes, and ensure an equitable ‘polluter pays’ stormwater management system. The primary mechanism for stormwater control in California is the National Pollutant Discharge Elimination System (NPDES) program, which was established under the Federal Clean Water Act and, in California, is enforced by the State and Regional Water Boards. Generally, municipalities must revise their local regulatory structure (e.g. codes and ordinances) to obtain the legal authority to comply with the requirements within the Municipal Stormwater NPDES Permit, including requirements for hydromodification control and LID. Municipalities may also, through their local regulatory structure, enforce additional stormwater control efforts specific to local watershed objectives.

Proponents of the LID approach cite its ecological benefits and cost effectiveness compared to constructing large scale stormwater collection infrastructure (Branden and Johnson 2004). However, individual site characteristics could make a significant difference to costs, benefits, and feasibility of LID implementation. Site attributes such as available space, slope and soil type constrain LID options and cost effectiveness (US EPA 2007a). For example, bioretention swales, which provide both water quality treatment and hydromodification control, are not suited to steep slopes or areas of high groundwater. Green roofs are less impacted by site constraints such as soil type, site slope or available ground but are much costlier and less effective than bioretention swales. Additionally, piecemeal site-scale management practices are inadequate as long term effective solutions to stormwater in urban watersheds and control measures also need to be implemented as a system, incorporating large-scale goals such as watershed restoration and preservation (NRC 2008).

California Municipal Stormwater NPDES Permits include stormwater control requirements for new and redevelopment, which include structural and non-structural requirements for LID. Because on-site compliance is not always feasible or appropriate, Regional Boards will generally include an option for off-site compliance so that Permittees can comply with their Permit. Municipalities, therefore, have the option of developing and using an ‘alternative compliance’ approach to regulate post-construction stormwater runoff from new and redevelopment. Alternative Compliance (AC) approaches such as stormwater ‘trading’ and fee-in-lieu payments are ways to meet hydromodification control and LID requirements for new and redevelopment *off-site* of the project, when on-site compliance may be infeasible. Alternative compliance programs have the potential to provide communities with a means to meet water quality objectives, including regulatory compliance and other natural resource protection goals, allow development flexibility, and facilitate efficiency (Thurston et al. 2003; Roy et al. 2006; Shuster et al. 2007).

While alternative compliance offers flexibility in meeting regulatory compliance and watershed objectives, there are potential pitfalls such as the difficulty in establishing performance equivalency of on-site and off-site locations, and the risk of inadequate mitigation. For example, wetland mitigation banking has been shown to not fully address losses of wetland function (Robertson 2006). Also, there may be extra costs associated with alternative compliance, such as identification of appropriate off-site locations and obtaining regulatory approval (e.g. collection of site information, hydrologic modeling) (Trauth and Shin 2005).

1.2 Problem Definition

The Central Coast Region is over 300 miles long and 40 miles wide and encompasses all of Santa Cruz, San Benito, Monterey, San Luis Obispo, and Santa Barbara Counties as well as the southern one-third of Santa Clara County, and small portions of San Mateo, Kern, and Ventura Counties (Fig.1). The region has a range of wet and arid climates and is geographically diverse, including urban and agricultural land use and habitat areas such as wetlands, dunes, forests, coastal chaparral and grasslands (CCRBP 2006). Over 2 million people live in the region, most of them in cities and towns on or near the coast, and development pressure remains an ongoing reality as more people are drawn to the region (CC 2011). The Central Coast Region has 150 streams and rivers, 22 beaches, 2 harbors, 5 lakes and 8 estuaries on the 303(d) list due to beneficial use impairments (e.g. recreation, aquatic life), and more than 40% of the listed waterbodies have urban stormwater related impairments (CCWB 2008). The Central Coast Regional Water Quality Control Board believes protecting watersheds, including groundwater recharge areas, aquatic habitat and riparian buffer zones will have the greatest impact on water quality improvement in the region over the long term (CCRBPTR 2009).

The Central Coast Regional Water Quality Control Board (CCRWQCB) will be requiring hydromodification control and LID for certain new development and redevelopment projects as part of their "Post-construction Stormwater Management Requirements for Development Projects in the Central Coast Region" (PCRs) for Municipal Phase I and II Stormwater NPDES permits (CCPCR 2012; CCTS 2012). Compliance with PCRs revolves around the use of structural and non-structural LID stormwater control measures and numerical performance-based criteria. A regional scale assessment of physical landscapes categorized urbanized portions of the Central Coast Region into ten Watershed Management Zones (WMZs) based on common key watershed processes (e.g., infiltration, groundwater recharge) and receiving water type (e.g., creek, marine nearshore waters). Each WMZ is aligned with specific post-construction stormwater management and numeric performance requirements to address the impacts of development on those watershed processes and beneficial uses (refer to Appendix B for map of WMZs in the Central Coast Region and performance requirements for runoff retention). A key principle underpinning the WMZs is that watershed processes need protection where they occur, "on-site", but not every site needs every process protected, and receiving waters have different sensitivity and do not need the same type or degree of protection in every location (CCTS 2012).

Figure 1: California's Central Coast hydrologic region and Counties located within the region.

The CCRWQCB defines alternative compliance as a programmatic approach undertaken by municipalities to provide an alternative to the uniform application of numeric performance criteria to all projects in their jurisdictions (JE 2012). Flexibility in meeting compliance is often desired by a municipality in order to have a venue to allow developers proposing a development project to pay the municipality a sum of money to implement stormwater controls at a different location within the watershed. Generally, the driving need for AC is that on-site compliance is infeasible due to cost and/or technical constraints. For example, in the Santa Clara Valley hydromodification management plan, matching pre-project runoff rates is considered 'impracticable' on-site if the overall cost of stormwater control measures exceeds 2% of project construction costs (SCV 2005). Alternative compliance may also provide an opportunity to direct stormwater funding to natural resource protection/restoration where it is of highest value in the watershed and to incentivize development in strategic areas and redevelopment in already impacted areas (Maupin and Wagner 2003; Trauth and Shin 2005).

The CCRWQCB allows Permittees under the NPDES Permit to use alternative compliance to meet parcel-scale new and redevelopment requirements for post-construction stormwater management. PCRs include provisions that define alternative compliance parameters and the language (refer to Appendix A) describes the situations in which AC can be used:

- Where technical feasibility issues preclude or severely limit the ability to comply with requirements (e.g. soil conditions, space constraints, high groundwater);
- Where the Permittee has a Watershed or Regional Plan approved by CCRWQCB that justifies AC as the off-site project is more consistent with overall watershed objectives to protect and improve watershed processes; or
- Where the Permittee has an Urban Sustainability Area (USA) designated and approved by CCRWQCB that allows off-site compliance when a project is located in a USA, which are areas designated to support infill of existing urban areas (e.g. redevelopment, high density, and transit-oriented development projects).

CCRWQCB also provides direction related to the location of the off-site project, schedule, and performance criteria. However, it will be the responsibility of the Permittee (i.e. city or county) to create their alternative compliance program.

The purpose of this report is to assist municipalities in meeting state and federal hydromodification and water quality control requirements by synthesizing the legal, environmental, technical and socioeconomic considerations of alternative compliance and developing a framework to create AC programs. Additionally, the report summarizes findings from a planning level exercise conducted with the City of Watsonville to evaluate the feasibility aspects of alternative compliance (refer to Appendix C).

1. 3 Overview of alternative compliance

Alternative Compliance (AC) is a term used to describe a provision offered by municipalities which allows developers to meet new and redevelopment requirements for stormwater control *off-site* of a project. Alternative compliance programs allow development to proceed provided there are no *net* environmental impacts and the programs can also be designed to achieve net environmental improvements. There are different types of scenarios which may be used to achieve alternative compliance for new development and redevelopment projects, and these can be classified in terms of the scale of the mitigation project, the different parties involved in the AC agreement, and the mechanism by which the mitigation project is funded.

In terms of project scale, the two AC mitigation types most applicable to the municipal stormwater framework are:

- *1:1 mitigation*, where an off-site project addresses on-site compliance only (e.g. a project hydraulically sized to control an equivalent quantity of stormwater runoff and pollutant loading).

- *Aggregate mitigation*, where an off-site project may address multiple on-site compliance projects (e.g. a regional project that collects runoff from multiple projects in the same watershed).

Alternative compliance requires an agreement between two parties. The three types of legal agreements most applicable to the municipal framework are:

- *public/private*, where the agreement is between a developer and a public agency (e.g. a fee in-lieu agreement between a developer and a municipality in which the developer pays a fee to address their stormwater impacts).
- *private/private*, where the agreement is between a developing property owner and another private entity (e.g. a voluntary agreement between developing property owners where an owner pays another owner to 'over-design' stormwater control measures to address runoff from both projects; or where a developer buys "stormwater credits" from a private seller/credit broker).
- *public/public*, where the agreement is between public entities (e.g. an internal mitigation banking agreement between a City sponsored bank and its transportation agency to address stormwater impacts of new roads).

The most common legal agreement is public/private but in all cases the Permittee is liable under the requirements of their stormwater NPDES permit. Therefore, municipalities will have some degree of involvement in all AC agreements (e.g. approving and tracking projects in private/private cases).

Alternative compliance requires mechanisms to fund off-site mitigation projects. The three types of funding options most applicable to the municipal framework are:

- *In-lieu fee*, where the developer or property owner pays a fee, the monetary amount necessary for the municipality to provide a proportional share of runoff treatment off-site (i.e., 1:1 or aggregate projects).
- *Developer mitigates off-site,* where the developer or property owner constructs a mitigation project off-site.
- *Credit trading,* where the developer or property owner purchases stormwater 'credits' through a private seller.

AC legal agreements are typically fee-based arrangements and this report will primarily focus on AC programs involving public/private agreements between developers and municipalities in which a developer pays a municipality a fee, in-lieu of managing runoff on-site.

2.0 Legal & regulatory framework

2.1 Legal authority for alternative compliance

The Porter-Cologne Water Quality Control Act is the principle law governing water quality control in California and applies to all State waters including surface waters and groundwater. The act establishes the tenet that waste discharges to State waters are a privilege and not a right (SWRPC 2011). The Porter-Cologne Act (commonly referred to as the California Water Code) provides the State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards (RWQCBs) with the authority to protect beneficial uses of waters of the State, establish water quality objectives, develop implementation programs to meet water quality objectives, and determine when state and federal water requirements are met (SWRCB 2004). RWQCBs have broad discretion to implement innovative natural resource protection programs because the Porter-Cologne Act allows them to regulate any activity or factor that affects water quality (LID 2007).

Federal and state legislative framework provides local agencies in California with authority to develop and implement alternative compliance programs. The Federal Clean Water Act (CWA) establishes a framework for regulating storm water discharges from municipal, industrial, and construction activities under the National Pollutant Discharge Elimination System (NPDES) program. Municipal separate storm sewer system (MS4) NPDES permits address post-construction runoff and hydromodification from new development and redevelopment through the implementation of Stormwater Control Measures (SCM) to the Maximum Extent Practical (MEP). The CWA also provides legal authority for U.S. Environmental Protection Agency (EPA) and States to develop alternative programs to control pollution and allows State authorities to incorporate alternative compliance provisions into NPDES permits (DEQ 2009). In California, municipalities must submit stormwater mitigation plans to RWQCBs to comply with MS4 NPDES permit requirements. Under the California General Plan Law, municipalities are required to develop policies and regulations that guide developments within their municipalities and facilitate the implementation of stormwater plans. Under the California Environmental Quality Act (CEQA), development projects are also subject to review for any adverse impacts, including impacts from stormwater discharges (CEQA 2011).

The legal canon defining alternative compliance requirements for stormwater management in California is not precise. California Water Code Section 13241 recognizes it is possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses (SWRPC 2011). The code states RWQCBs must take into account the need for economic development, housing and other environmental benefits when establishing water quality objectives such as new and redevelopment compliance requirements. Alternative compliance is intrinsically linked to regulatory requirements- it explicitly addresses alternative ways to comply with certain regulatory requirements (Roques 2011). Federal and State legislation provides authority to develop alternative compliance programs but do not provide specific program requirements or implementation criteria. In California, specific alternative compliance program parameters can be included in the municipal stormwater NPDES Permit (e.g. situations in which AC may be allowed, mitigation schedules, and type of mitigation activity). CCRWQCB has established parameters by which alternative compliance may be implemented in the Central Coast Region (refer to Appendix A). Municipalities can then develop and implement an AC program within their own local regulatory structure to ensure all legal elements are addressed.

A key regulatory issue for including new development and redevelopment in an AC program is the definition of 'Maximum Extent Practicable' (MEP), the statutory standard for SCM implementation. The principle of MEP is to take all the actions that can be reasonably taken in order to prevent water quality degradation from non-point source pollution. The State Water Resources Control Board's Office of Chief Counsel issued a 1993 memorandum interpreting the meaning of MEP to include technical feasibility, cost, and benefit derived, with the burden being on the municipality to demonstrate compliance with MEP by showing that a SCM is not technically feasible in the locality or that SCMs costs would exceed any benefit to be derived (CWBLAR 2011). The MEP standard is a potential constraint on AC implementation because it may be difficult to quantify and compare at different locations.

2.2 State and Federal regulations and policies supporting alternative compliance

While a long-standing history of AC related to municipal stormwater management does not exist, there are numerous federal and state agreements, policies, and guidance documents that support the concept of off-site compliance and provide valuable information when developing an AC program:

- *The 1990 Mitigation Memorandum of Agreement (MOA)* between the EPA and the Department of the Army, under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, permits off-site mitigation if on-site mitigation is not practicable (EPA 1990). The objectives of the MOA are to allow compensatory mitigation projects designed to replace wetlands and other aquatic resource functions protected under the Acts and to meet the goal of no overall net loss of wetlands and other aquatic functions and values (EPA 1990). The objectives of MOA are not specific to stormwater mitigation however its guidance documents provide insight into fee-based off-site mitigation.

- The *Federal Guidance on the Use of In-Lieu-Fee Arrangements for Compensatory Mitigation* (ILF Guidance*)* (ILF 2000) provides guidance for off-site mitigation under MOA. In-lieu fee arrangements under Section 404 occur in circumstances where a permittee provides funds to an in-lieu-fee sponsor (usually a state agency, land trust, or conservation organization) instead of either completing project-specific mitigation (i.e., on-site) or purchasing credits from a wetland mitigation bank (ILF 2000). When a permittee pays an in-lieu fee, liability for compliance shifts from the permittee to the in-lieu fee sponsor and the permittee typically has no further responsibility for the off-site mitigation. In-lieu fee arrangements do not typically provide mitigation in advance of project impacts (ELI 2006). The ILF guidance strengthened the standards for operating an in-lieu- fee program by requiring prospective program sponsors to provide information on potential sites in advance of establishing a program, also a potentially important consideration when establishing fee-in-lieu programs for stormwater management.

- The *Federal Guidance for the Establishment, Use and Operation of Mitigation Banks* (FED 1995) provides guidance on establishing banks for Section 404 mitigation. A mitigation 'bank' is a fee based alternative compliance program which typically provides mitigation in advance of impacts, for purchase later as mitigation credits. When a developer purchases credits from a bank, mitigation liability shifts from the developer to the mitigation bank sponsor (typically a private entity that constructs and maintains the off-site project) and the developer has no further responsibility for the off-site mitigation. Mitigation banking has been endorsed by California's State Water Board for stormwater mitigation. For example, the Los Angeles Region Water Quality Control Board adopted and approved requirements for new and redevelopments in 2000, the State Board affirmed the Regional Board action in State Board Order No. WQ 2000-11, and the State Water Board's Chief Counsel "interprets the Order to encourage regional solutions and endorses a mitigation fund or 'bank' that may be funded by developers who obtain waivers from the numerical design standards for new development and significant redevelopment" (p.11, CWBLAR 2011).

- *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule* (EPA 2008). In 2008, EPA and the U.S. Army Corps of Engineers, through a joint rulemaking, expanded the Section 404 guidelines to include comprehensive standards to improve the effectiveness of all three mechanisms for providing compensatory mitigation: in-lieu fee mitigation; mitigation banking; and Permittee-responsible mitigation (refer to Box 1). The standards include 12 fundamental components: objectives; site selection criteria; site protection instruments (e.g. conservation easements); baseline information (for impact site and mitigation site); 'credit' determination methodology; a mitigation work plan; a maintenance plan; ecological performance standards; monitoring requirements; a long-term management plan; an adaptive management plan; and financial assurances (EPA 2008). These components illustrate the type of requirements which might be used to establish AC agreements for stormwater management.

Box 1: Mechanisms for off-site compensatory wetland mitigation under Section 404 of the Clean Water Act (from U.S. EPA 2008)

"In-Lieu Fee Mitigation: A permit applicant may make a payment to an in-lieu fee program that will conduct wetland, stream or other aquatic resource restoration, creation, enhancement, or preservation activities. In-lieu fee programs are generally administered by government agencies or non-profit organizations that have established an agreement with the regulatory agencies to use in-lieu fee payments collected from permit applicants.

Mitigation Banks: A permit applicant may obtain credits from a mitigation bank. A mitigation bank is a wetland, stream or other aquatic resource area that has been restored, established, enhanced, or preserved. This resource area is then set aside to compensate for future impacts to aquatic resources resulting from permitted activities. The value of a bank is determined by quantifying the aquatic resource functions restored, established, enhanced, and/or preserved in terms of "credits." Permittees, upon approval of regulatory agencies, can acquire these credits to meet their requirements for compensatory mitigation.

Permittee-Responsible Mitigation: A permittee may be required to provide compensatory mitigation through an aquatic resource restoration, establishment, enhancement and/or preservation activity. This compensatory mitigation may be provided at another location, usually within the same watershed as the permitted impact. The permittee retains responsibility for the implementation and success of the mitigation project.

Mitigation banks and in-lieu fee mitigation are forms of "third-party" compensation because a third party, the bank or in-lieu fee sponsor assumes responsibility from the permittee for the implementation and success of the compensatory mitigation."

- *EPA's Water Quality Trading Policy* (WQT) is intended to offer an economically efficient alternative means of achieving clean water goals while allowing for community growth (EPA 2003). It represents a recognition that different pollutant sources may have different costs for reducing pollution charges, that different activities have different impacts on the economy of a community and that communities should be allowed flexibility to meet water quality criteria (Trauth and Shin 2005). The policy allows one source to meet its regulatory obligations by using pollutant reductions created by another source that has lower pollution control costs, with the requirement that no trade can exceed water quality criteria anywhere within a waterbody (EPA 2003). Credit trades typically have a limited life span and the developer retains liability for the off-site mitigation after the credit purchase (unless credits are purchased from a private seller). WQT policy guidance (EPA 2003, 2004a, 2007b) provides guidelines for water quality trading such as nutrient trading in watersheds with TMDLs. The policy guidance also describes an example where flow is used as the trading parameter across wet weather sources, which may support an AC approach of 'trading' stormwater between on-site and off-site locations (USEPA 2007b).

- *Standard operating procedure for determination of mitigation ratios* (USAC 2012). In 2012, U.S. Army Corps of Engineers South Pacific Division established procedure for determining compensatory mitigation ratios for permits under Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act, and Section 103 of the Marine Protection, Research, and Sanctuaries Act. A mitigation ratio, commonly called a 'trading ratio' is a factor-of-safety built into a trade which weights the trade to account for spatial and temporal differences between locations, and reduce uncertainties regarding mitigation equivalency between the impacted site and the mitigation activity. Factors considered in the procedure include: impact-mitigation comparison; mitigation site location; net loss of aquatic resource surface area; conversion of mitigation type; uncertainty of success; and temporal loss (USAC 2012). The procedure provides a decision-making framework for addressing concerns which could be important to stormwater AC programs such as quantitative and qualitative assessment of on-site impact and off-site mitigation, uncertainty of SCM effectiveness, and lag time between construction of on-site and off-site projects.

- *Smart growth* is a development approach supported by the EPA which encourages regional cooperation and planning by integrating land use planning and water resource protection at the watershed level. Smart growth principles direct development into strategic areas and provide a framework for innovative funding and fee structures which support off-site mitigation (EPA 2004b).

2.3 Scope of potential alternative compliance solutions

While most federal and state agreements and policies related to AC are not directly associated with local stormwater management regulation for new and redevelopment, their policy guidance provide insight into requirements and implementation criteria potentially useful for stormwater alternative compliance programs. For example, federal policies on water quality trading and fee in-lieu mitigation for loss of wetlands and other aquatic resource functions caused by dredge/fill impacts provide instruction on site scale environmental impacts and required mitigation. The scope of potential alternative compliance solutions is illustrated below using key sections and concepts from these guidance documents including trading currency, allowable mitigation type, quantifying performance and equivalency, hierarchy of mitigation options, location of off-site projects, ownership of off-site property, implementation deadlines, and funding requirements. Examples from existing alternative compliance programs will be used to illustrate the scope of potential AC solutions within the context of AC language in the Central Coast Region's PCRs (Appendix A).

Trading currency

'Trading' is a general term used to describe the exchange that occurs between parties in an alternative compliance agreement and 'trading currency' is the unit of trade. Generally, units of trade must be clearly defined for trading to occur. For example, the currency in water quality trades is typically a nutrient pollutant such as nitrate and a trade may occur between the 'buyer' of nitrate treatment (e.g., a developer) and the 'seller' of nitrate treatment (e.g., a farmer with nitrate BMPs). WQT policy does not allow trades between 'buyers' and 'sellers' of different currencies, known as 'cross trading', unless there is adequate information to correlate impacts on water quality such as a defined or established translation ratio (US EPA 2007b):

"A condition for water quality trading is identification of a pollutant commodity (trading currency) that can be sufficiently controlled, measured, and traded by sources. Pollutant specific credits are examples of tradable units. Generally a single pollutant should be identified in a common form and potential trading partners should not trade 'apples and oranges'. In some cases, different pollutant types (e.g. total phosphorus and dissolved oxygen) can be traded using a defined translation ratio based on the quantities of each that have an equivalent overall effect on water quality" (EPA 2004b).

Refer to Box 2 for an example of cross trading in the WQT context.

Box 2: Cross trading of phosphorous and dissolved oxygen in the Rahr Malting Company water quality trade in Minnesota (from Breetz et al. 2004)

The Rahr Malting Company negotiated an agreement with the Minnesota Pollution Control Agency (MPCA) to offset carbonaceous biochemical oxygen demand (CBOD) discharge from its new wastewater treatment plant by funding farmers' upstream nonpoint source phosphorus reductions.

When cross-pollutant trades occur, a ratio that equates the two pollutants must be developed. The MPCA based the ratio on the research correlating phosphorus with chlorophyll-a and chlorophyll-a with CBOD. The phosphorus to CBOD ratio is 1:8 in addition to a 0.75 safety factor for soil phosphorus content. Furthermore, the trade is discounted using delivery trading ratios (DR) to account for location. A DR of 100% is used for riparian areas, but the DR is reduced to 20% for lands within a quarter mile and 10% for lands further away.

MPCA specified that acceptable trading projects include soil erosion BMPs, livestock exclusion, rotational grazing, wetland restoration, and land set-asides. Rahr achieved the nonpoint source credit requirements through four trades. Two projects converted farmland back to floodplain by restoring vegetation and setting aside the land through easements. Two projects stabilized eroding stream banks with structural work, one of which additionally included livestock exclusion.

Ecosystem service markets typically trade in several kinds of currencies and avoid 'cross trading' between currencies. Refer to Box 3 for an example of accounting for different mitigation types within the Willamette Valley ecosystem services market in Oregon.

Box 3: The Willamette Partnership ecosystem credit accounting for multiple ecosystem services in Oregon (from WP 2012).

The Willamette Partnership is a diverse coalition of conservation, city, business, farm, and science leaders in the Willamette River basin, Oregon, that has developed an ecosystem market approach to accommodate urban growth, provide large scale ecosystem restoration, and reward voluntary actions on private lands.

The Ecosystem Credit Accounting System represents agreement among federal, state, and local agencies and is a package of protocols and tools that allow buyers and sellers to trade in multiple types of ecosystem credits including wetlands, salmon habitat, and the water temperature benefits created from riparian restoration. Standard rules, methods, and processes are essential for legitimately translating ecological data into a "credit" that can legally offset an impact. Each impact has a different trading currency and fee rate and there is no trading between currencies:

- Wetland credits are traded as functional acres and calculated using the Oregon Rapid Wetland Assessment Protocol (ORWAP), and a wetlands focus group assigned rules for converting ORWAP scores into quantities of functional acres as tradable credits.
- The Salmon Credit Calculation Method calculates scores for six ecological functions relevant to optimal habitat for the range of salmonid species. The output of the metric is a weighted linear foot that is based on the percentage of optimal functions performed by the stream and near-stream habitat.
- Shade credits are determined using the Oregon Department of Environmental Quality Shade-O-Later model to predict the thermal benefit of increased shade provided by restoration plantings. Credits are defined as modeled temperature reductions measured in kcal/day that would be generated from restoration plantings at full maturity.

In the realm of stormwater management, a trading currency based on the regulatory requirements (e.g., numeric requirement for runoff volume or impervious surface area) may be most appropriate. For example, stormwater regulatory requirements in West Virginia are based on runoff reduction, runoff volume is the currency of their AC programs, and runoff reduction credit is given to tree planting based on canopy/interception (refer to Box 4 for an example of assigning runoff reduction values to reforestation projects). In contrast, temperature reduction is a regulatory requirement and trading currency in Oregon and the Willamette Valley ecosystem market (Box 3) gives shade/temperature reduction credit to tree planting. The Central Coast Region's PCRs include numeric performance criteria for runoff retention therefore runoff volume may be the most appropriate trading currency for AC programs in the region.

Box 4: Assigning runoff reduction values to reforestation projects in West Virginia (WVDEP 2012).

"Off-site mitigation projects in West Virginia can include reforestation projects that reduce the volume of runoff compared to existing site conditions. Reforestation is defined as planting trees on pervious or disturbed areas at a rate that would produce a forest-like condition over time. The intent of the planting is to eventually convert the area to forest. If the trees are planted as part of the landscape, with no intention to covert the area to forest, then this would not count as reforestation. Examples may include:

- Reforestation of disturbed or barren lands (e.g., old logging or mining sites or areas where previous disturbance has not been stabilized).
- Reforestation of riparian corridors that are currently in turf, pasture, overrun with invasive plants, and/or disturbed.
- Reforestation of turf, preferably on public property, such as turf areas at schools, parks, municipal buildings, and other areas that are not actively used (e.g., for sports fields or areas that must remain open).
- Reforestation or revegetation of areas where existing impervious area is removed, such as unused parking lots or abandoned properties.

If a reforestation project takes place on a development site in such a way that it is used to help achieve compliance with the site's stormwater requirements then it cannot also be used to provide volume offsets as part of a local off-site compliance program."

Monitoring studies (which measured the proportion of rainfall removed through processes such as interception, transpiration, and infiltration) were used to estimate a 30% runoff reduction benefit provided by trees. To derive volumetric reduction values, runoff coefficients for reforestation projects were established to represent a 30% reduction from managed turf/disturbed condition (i.e., reforestation coefficients are between those for managed turf/disturbed soils and forest/open space). The incremental volume represents the volume reduction achieved by the restoration project. For projects that also utilize soil amendments/soil restoration, the runoff coefficients for the next 'lower' hydrologic soil type can be used (e.g., type C soil goes to type B soil).

Performance requirements for reforestation projects in West Virginia include a minimum planting density of 100 trees per acre and the mitigation area should have a minimum contiguous area, such as 1 acre. The mitigation area must be protected by a perpetual easement or other property restriction that assigns the responsible party to ensure that no future development, disturbance or clearing may occur within the area. It is also recommended that privately owned and maintained sites post a performance bond to fund replacement of the entire project if necessary.

Allowable mitigation type

Existing AC policy and programs vary widely in the type of mitigation activities they allow to generate trading 'credit'. The FED (1995) guidelines for AC refer to the concept of 'in-kind' and 'out-of-kind' compensatory mitigation where 'in-kind' means a resource of a similar structural and functional type to the impacted resource, while 'out-of-kind' refers to a resource of different structural and functional type. The guidelines state a preference for 'in-kind' mitigation but may allow 'out-of-kind' mitigation if it achieves a greater ecological value:

"The objective of a mitigation bank/in-lieu fee arrangement is to provide for the replacement of the chemical, physical and biological functions of wetlands and other aquatic resources which are lost as a result of authorized impacts. The newly established functions are quantified as mitigation 'credits' which can be used to compensate for adverse impacts (i.e. 'debits')."
"In-kind compensation of wetlands and other aquatic resource impacts should generally be required. Out-of-kind compensation may be acceptable if it is determined to be practicable and environmentally preferable to in-kind compensation (e.g. of greater ecological value to a particular region, provides more watershed benefit than in-kind compensation)." (FED 1995).

The type of allowed mitigation may depend on degree of risk and uncertainty of the mitigation, site feasibility or watershed priorities. EPA (2008) guidance for mitigation under Section 404 of the CWA states:

"in-kind replacement generally is required when the impacted resource is locally important".

For example, some wetland trading programs only allow off-site mitigation when the type of wetland (e.g. tidal) compensation is the same as the wetland impacted. Also, the Washington D.C. stormwater retention program only permits fees from their in-lieu fees program to be spent on off-site projects which provide runoff retention (DCGB 2012). In contrast, AC language in many NPDES permits list a broad range of off-site projects allowed in their AC programs. For example, Henrico County, Virginia, administers a fee-in-lieu for their watershed management AC program based on pollutant removal. This 'environmental fund' is used to finance projects such as streambank stabilization, stream restoration, removal of stream obstructions, buffer establishment, regional best management practices and constructed wetlands (HC 2013). For another example, acceptable off-site projects in the Ventura County NPDES permit include regional and sub-regional hydromodification control BMPs, stream restoration, green streets programs, parking lot retrofits, wetland restoration and localized rainfall storage and reuse (CWBLAV 2010). Some practices can be directly related to runoff retention and peak management compliance requirements for Ventura County (e.g. parking lot retrofits, rainwater harvesting) and could be considered 'in-kind' mitigation. Other activities have a more indirect link to compliance but may ultimately improve water quality (e.g. wetland restoration) and might be considered 'out-of-kind' mitigation for the Ventura County program.

Stream restoration is not typically related to runoff retention however provisional methodologies have been developed to assign runoff reduction values to stream restoration projects therefore this type of mitigation activity might be considered 'in-kind' in some stormwater AC programs (refer to Box 5 for an example of assigning runoff reduction values to stream restoration projects).

Box 5: Assigning runoff reduction values for stream restoration projects in West Virginia. (WVDEP 2012).
The use of stream restoration as a best management practice for reducing sediment and nutrients in urban watersheds is becoming commonplace and there are established protocols for crediting sediment and nutrient load reductions associated with various stream restoration approaches. Assigning volume reduction credit to stream restoration practices is more challenging however a provisional methodology is included in West Virginia's guidelines for off-site stormwater compliance. The guidelines describe two methods for assigning a runoff reduction equivalent value for stream restoration projects: (1) the equivalent BMP approach and (2) the site assessment approach.

The equivalent BMP approach uses a 'typical' stormwater BMP and drainage area for which both runoff reduction and pollutant removal values are known and accepted in West Virginia and then equates the equivalent linear feet of stream restoration needed to achieve the same pollutant removal. The approach assumes bioretention stormwater treatment as the benchmark, 1 acre drainage with 100% imperviousness and soil type C, an annual rainfall of 43 inches, and a target rainfall event of 1 inch. This approach yields a stream restoration equivalent value of 45 cubic feet of volume reduction for each linear foot of stream restoration.

The site assessment approach is a four step process which involves estimating stream sediment erosion rates from the 'degraded' site proposed to be restored, converting stream bank erosion rates to nutrient loadings, estimating reduction efficiency attributed to stream restoration, and equating pollutant reduction with equivalent runoff reduction for the bioretention benchmark. This method is more sophisticated than the equivalent BMP approach and requires site-specific assessment of bank conditions as well as data for stable reference streams.

Preferred sites for stream restoration projects include:

- Sites identified as needing restoration in a watershed management plan, stormwater master plan, or similar document.
- Sites where an entire degraded/unstable reach or segment will be restored.
- Sites which have additional conservation values (community streamside trail system, connectivity to a park, community open space, or other conservation feature (riparian buffers, etc.).
- Sites that allow for an adequate (e.g., 50 foot minimum) and permanent buffer protection.
- Sites with "entrenched" streams that have lost access to their floodplains during a wide range of storm events, and where restoration can serve to reconnect the stream to its floodplain (this approach will more likely result in runoff reduction benefits because a higher percentage of storm flows will be spread across a broader and vegetated floodplain area).

A watershed planning approach may allow for a broader interpretation of allowable mitigation types. For example, land banks are a type of mitigation bank that are an 'allowable mitigation type' in some AC programs as part of a watershed plan. Lake Tahoe Watershed land coverage trading program uses a land bank to transfer and mitigate impervious surface area from new and existing development (SRG 2003). Regional plans in the Tahoe watershed created limits on the amount of impervious surface on individual parcels and in the watershed to protect water quality in the Lake (SRG 2003; Hurd 2009). A State agency, California Tahoe Conservancy, purchases land for preservation and then resells the development rights from that land through its Land Coverage Bank. Property owners in Tahoe are allowed to buy extra impervious surface beyond their impervious surface allocation from the bank and can also sell 'excess' pervious surface area to the bank (SRG 2003). Transfer of Development Rights (TDR) programs have also been used in the central coast region of California (e.g., Cambria, Goleta) to prevent urban sprawl and preserve resources (SRG 2003; Fulton et al. 2006).

Central Coast Region's PCRs for runoff retention stipulate the type of mitigation needed in the different WMZs (e.g. infiltration treatment in WMZ 1) (refer to Appendix B). However, proposed AC language (Appendix A) does not require offsite mitigation treatment match WMZs compliance requirements nor does it mandate specific SCMs therefore municipalities may tailor allowable mitigation types to their watershed and community needs.

Quantifying performance and on-site/off-site equivalency

In most AC programs, the quantity of required off-site mitigation is determined by the quantity of on-site mitigation that cannot be achieved. To create a performance 'credit', the off-site project mitigation (e.g., runoff reduction) must exceed the stormwater control requirements for the project (e.g., implementation of SCMs to MEP standard). Whatever mitigation activities are chosen (i.e., in-kind and out-of-kind activities), off-site projects are typically required to account for the quantity of mitigation treatment (e.g., change in volume, water quality or impervious surface before and after treatment) and demonstrate the off-site 'credit' is equal to or more protective than the on-site compliance requirement (CWP 2010). The Central Coast Region's PCRs, like most NPDES permits and regulations evaluated for this report, do not specify a method for quantifying off-site mitigation performance. A range of methodologies can be used to quantify the performance of off-site projects and the degree of sophistication of the method employed may depend on the size and perceived risk of the unmitigated on-site impact and off-site mitigation project.

Continuous hydrologic simulation modeling is often recommended in NPDES permits to assess performance of on-site stormwater treatment measure and this method may also be suitable for demonstrating performance of large regional off-site mitigation projects and for a watershed-scale AC programs. For example, the Bay Area Hydrology Model (BAHM) is a continuous simulation hydrologic model used by counties in the San Francisco Bay region. The model incorporates local runoff and precipitation data to analyze hydrograph modification effects of development projects and could be used to assess hydraulic equivalence of structural SCMs for offsite compliance projects (BAHM 2011). Smaller off-site projects (e.g., 1:1 mitigation) are often assessed using less complex methods such as spreadsheet models or simple pervious acreage calculations. Spreadsheet models are typically used to estimate size requirements of different stormwater treatments on-site and translate them into the same units of measure (e.g., runoff volume reduced, pollutant load reduced) in order to compare various mitigation scenarios and optimize runoff management. Spreadsheet models can be also be used for off-site mitigation assessment. Refer to Box 6 for a description of the spreadsheet model used in Virginia's stormwater management program. The model utilizes a balance sheet approach based on land cover runoff coefficient methods and SCMs storage volumes to estimate the mitigation of runoff and estimate in-lieu fees.

Box 6: The runoff reduction method spreadsheet model used in Virginia (CSN 2008).

The 'runoff reduction method' spreadsheet model was created to help stormwater managers comply with regulations for new development and redevelopment in the State of Virginia. Runoff reduction is defined as the total annual runoff volume reduced through canopy interception, soil infiltration, evaporation, transpiration, rainfall harvesting, engineered infiltration, or extended filtration. The runoff reduction method relies on a three-step compliance procedure, with a potential fourth step if alternative compliance is required:

<u>Step 1. Calculate site-specific treatment volume and phosphorus load reduction:</u>

Treatment Volume is the central component of the runoff reduction method and is the main 'currency' for site compliance. The runoff reduction method uses a spreadsheet to compute runoff coefficients for forest, disturbed soils, and impervious cover and to calculate a site-specific target treatment volume and phosphorus load reduction target.

<u>Step 2. Apply runoff reduction practices:</u>

Various structural and non-structural SCMs have been assigned runoff reduction rates based on an extensive literature search, and managers utilize the spreadsheet model to experiment with combinations of nine runoff reduction practices. In each case, the manager estimates the area to be treated by each runoff reduction practice to incrementally reduce the required treatment volume for the site.

<u>Step 3. Compute pollutant removal by selected SCMs:</u>

In this step, the manager uses the spreadsheet to see whether the phosphorus load reduction has been achieved by the application of runoff reduction practices.

Step 4. Fee-in-lieu payment:
In this step, a fee-in-lieu payment is calculated to compensate for any load that cannot feasibly be met on particular sites. The fee would be based on the phosphorus "deficit" – that is, the difference between the target reduction and the actual site reduction after the application of runoff reduction and pollutant removal practices. The fee is calculated by multiplying runoff mitigation volume by a flat rate cost per gallon.

The runoff reduction spreadsheet model allows SCMs to be assessed on a common basis (i.e., treatment volume) and thus assists with optimizing SCM selection. Model calculations of treatment volume explicitly acknowledge the difference between forest and turf cover and disturbed and undisturbed soils, which creates incentives to conserve forests and reduce mass grading and provides a defensible basis for computing runoff reduction volumes for these actions. The runoff reduction framework has been adopted by other states and jurisdictions (e.g., District of Columbia, Maryland, Pennsylvania and West Virginia) and modified to suit their unique conditions and water resources protection objectives.

The WQT policy recommends developing a protocol to establish a baseline level of best management practices implementation (e.g., MEP) for nonpoint source pollution sources such as new development and redevelopment; modeling and monitoring BMP effectiveness to quantify project performance (e.g. runoff volume mitigated); and using trading ratios to equalize the trade between off-site and on-site projects (US EPA 2003). A trading ratio greater than 1:1 may be used for additional environmental improvements and to reduce uncertainties regarding BMP effectiveness, water quality impacts and mitigation equivalency:

"In some cases, the credit generation of the BMP could be prorated on the basis of the pollutant reduction the BMP is achieving during the current reconciliation period, even where the BMP has not reached its maximum expected pollutant reduction efficiency. This could be reflected in the trading ratio. The permitting authority should decide whether and when a credit expires, if the BMP becomes less effective over time and is not maintained or replaced" (US EPA 2004b).

Some stormwater AC programs use trading ratios to improve potential environmental gains of trade but typically do not account for specific spatial and temporal differences between on-site and off-site projects. For example, the City of Fredericksburg, Virginia, has developed trading ratios of 1.5:1 for new development projects (i.e., the off-site project must mitigate 1.5 times the amount of runoff not mitigated on-site) and 1.25:1 for redevelopment projects using off-site compliance (WVDEP 2012). Both ratios are greater than 1:1 which may provide net environmental gain. Trading ratios may also be used to reduce the overall risk of AC programs and discourage overuse of off-site compliance. For example, the West Virginia MS4 General Permit established a one inch runoff reduction on-site performance standard and a trading ratio of 1.5:1 for the first 0.6 inches traded for an off-site practice and 2:1 for the subsequent 0.4 inches (WVDEP 2012).

AC projects with runoff volume as a trading currency demonstrate off-site project are equal to or more protective than the on-site compliance by quantifying runoff using the hydrologic models and potentially applying trading ratios. Assessing the equivalency between an on-site impact and off-site 'out-of-kind' mitigation project is more difficult because the projects usually lack a common trading currency (e.g., runoff volume and wetland units). Many AC programs evaluate out-of-kind activities on a case-by-case basis and some jurisdictions such as Henrico County, Virginia, have developed weight of evidence methods to assess and quantify the benefits of mitigation projects within a broader watershed planning context using multiple weighting criteria including habitat and stream restoration, as well as parcel-scale assessment criteria (HC 2013) (refer to Box 7 for more detail on weighting methodologies). The EPA (2008) guidance supports a watershed planning approach to assess the performance of out-of-kind mitigation activities:

"The best tool for determining whether off-site or out-of-kind compensatory mitigation is environmentally preferable is a holistic watershed plan incorporating mitigation and restoration priorities. …In the absence of a holistic watershed plan, evaluations of mitigation options should take into account a wide range of factors such as: site conditions that favor or hinder success; the needs of sensitive species; chronic environmental problems such as flooding or poor water quality; current trends in habitat loss or conversion; current development trends; and the long term benefits of available options" (EPA 2008).

The Central Coast Region AC language has an option to use a Watershed Plan to justify runoff retention and peak management for a regulated project which may leave open the possibility for cross-trading and out-of-kind mitigation (e.g., trading runoff volume and stream restoration) if it can be demonstrated that the implementation of those projects can be as effective in maintaining watershed processes as implementation of applicable on-site requirements (Appendix A). The AC language states that proposals for AC projects implemented under a watershed plan, regional plan, or USA must include quantitative analysis (e.g., calculations and modeling) used to evaluate offsite compliance.

Hierarchy of mitigation options

In order to reduce risk and uncertainty of mitigation projects (particularly 'out-of-kind' mitigation) and help ensure that the required compensation is provided, EPA (2008) guidance establishes a preference hierarchy for mitigation options based on the likely timing, size, and scale (e.g., watershed or site-by-site approach), funding mechanism (e.g., mitigation banking, fee-in-lieu) and mitigation type (e.g., in-kind or out-of-kind mitigation) of off-site project implementation:

"The most preferred option is mitigation bank credits, which are usually in place before the activity is permitted. In-lieu fee program credits are second in the preference hierarchy, because they may involve larger, more ecologically valuable compensatory mitigation projects as compared to permittee-responsible mitigation. Permittee-responsible mitigation is the third option, with three possible circumstances: (1) conducted under a watershed approach, (2) on-site and in kind, and (3) off-site/out-of-kind" (EPA 2008).

An example of preference hierarchy in AC programs is Maryland's Critical Area Program. The Critical Area program was created to protect tidal area in Chesapeake Bay and to oversee land use and development (CWPM 2003). The following is a prioritized list of potential off-site projects for intensely developed areas: (1) construction and operation of an off-site BMP; (2) retrofit an existing BMP; (3) retrofit an existing storm drain system to encourage infiltration; (4) reduce the imperviousness of an existing property through reforestation; (5) implement a riparian reforestation project; (6) in rural jurisdictions where retrofit options are limited, finance the installation of a structural agricultural BMP for a farm; (7) restore a degraded tidal or non-tidal wetland (CWPM 2003). Weighting criteria is typically used to create a preference hierarchy of projects. Refer to Box 7 for a description of the weighting methodology developed by West Virginia to rank and prioritize off-site projects in their stormwater AC program, based on benefits and costs criteria.

Box 7: Methodology for weighting and prioritizing potential mitigation projects in West Virginia (WVDEP 2012).

West Virginia's guidelines for off-site stormwater compliance include a methodology to score and rank mitigation projects. The objective of the weighting process is to prioritize the most beneficial projects from an inventory of potential projects and the main steps involve choosing ranking criteria and developing scoring and weighting structure.

In order to compare the benefit of one mitigation project over another, factors are selected which serve as points of comparison. Proposed projects may be ranked based on their pollutant reduction performance, habitat creation capabilities, capital and long-term cost, and community education and outreach potential. Ranking criteria may include: cubic foot of runoff reduced; total construction costs; cost per cubic foot reduced; cost per pollutant removed; compatibility with watershed goals; maintenance burden; landowner cooperation; interaction with other restoration practices; access; public feasibility; and habitat creation.

Many combinations of ranking criteria can be used and a selection of three to eight criteria is recommended so that the process is comprehensive but not overly complicated. In order to reduce ambiguities or personal bias, it is recommended that objective/numeric criteria (e.g., cost) should constitute at least half of the selected criteria, versus more subjective factors (e.g., public visibility). Most importantly, ranking criteria should reflect watershed goals and public needs in the watershed or jurisdiction. For example, if a watershed is impaired due to excessive bacteria then bacteria treatment performance should be one of the ranking criteria for mitigation projects.

Once the ranking criteria have been selected, the next step is to assign a relative weight of importance to each ranking criterion that reflects its perceived influence on the success of a mitigation project. Within each ranking criterion, standards are set to determine a high or low score within that category and the associated range of scores. For example:

- Cubic Foot Runoff Reduced: This criterion ranks the volume of stormwater runoff that can be captured and reduced by the proposed practice. The other side of the equation is cost to implement SCMs, the cost per cubic foot reduced.
- Compatibility with watershed goals: maximum points might be awarded for projects that directly support restoration goals (e.g., a fish barrier removal project in a watershed where native trout

recovery is the major objective), and fewer points awarded to projects that only indirectly support watershed goals (e.g., a stream repair project in a watershed where pollution reduction is the primary goal).

- Maintenance burden: this factor should not only estimate future maintenance costs but also whether a responsible party exists to do it. The long-term maintenance needs of each project should be assessed and points deducted if vegetation management, sediment removal and clogging are expected to occur frequently. Points may also be deducted if maintenance is not clearly vested with a responsible party.

Municipalities in the Central Coast Region may establish their own hierarchy of mitigation options or prioritization criteria tailored to their community/watershed needs within their jurisdictions.

Location of off-site projects

There is general agreement that off-site mitigation locations and on-site locations should be within the same watershed (McKenney 2005; US EPA 2003). This is based on the premise that compensation should accrue to affected areas (McKenney 2005). However there is variability in the literature as to whether an off-site location should be above or below the on-site location, and this variability may be dependent upon type and condition of receiving water (e.g. existing TMDL), pollutant of concern, and local hydraulics and hydrology. Proposed AC language for the Central Coast (Appendix A) requires off-site projects to be within the same watershed as regulated projects however the language does not include upstream or downstream stipulations.

Because of the EPA requirement that water quality trading cannot result in water quality standards being exceeded anywhere within the waterbody of interest, many trading programs require the off-site location to be upstream of the on-site location in order to avoid creating a situation where the increased pollutant discharge upstream results in a violation of water quality standards known as a 'hot spot' (Trauth and Shin 2005). For example, location preference is described by the EPA in relation to TMDL trading:

"All water quality trading should occur within a watershed or a defined area for which a TMDL has been approved. Establishing defined trading areas that coincide with a watershed or TMDL boundary results in trades that affect the same water body or stream segment and helps ensure that water quality standards are maintained or achieved throughout the trading area and contiguous waters" (US EPA 2003).

Studies involving mitigation of runoff volume and flow control tend to prefer off-site projects to be located downstream of urban development. For example, regional retention projects are designed to retain runoff from urbanized areas therefore they are best located downstream of on-site projects (Maupin and Wagner 2003; VC 2011). The concept of locating the mitigation downstream of the project is that the runoff pollutants and volume that could not be addressed at the on-site project might be captured downstream at the mitigation site.

The FED provides another example where preferred location is stated, in which compensatory mitigation consists of restoration/protection of aquatic resources that are similar to the aquatic resources of the impacted area. FED guidelines require off-site projects to be located in the same geographic area as the impacted area, and planned and developed to address the specific resource needs of a particular watershed (ILF 2000).

"Mitigation should be undertaken, when practicable, in areas adjacent or contiguous to the discharge site, and if on-site compensatory mitigation is not practicable, off-site compensatory mitigation should be undertaken in the same geographic area if practicable (i.e., in close proximity and, to the extent possible, the same watershed)" (ILF 2000).

The concept of locating off-site and on-site projects in the same geographical area to mitigate similar ecological functions is consistent with the principle of Watershed Management Zones in the Central Coast Region's PCRs (Appendix B). Proposed AC language (Appendix A) does not require an off-site project use the type of mitigation recommended for its WMZ and municipalities may wish to establish more restrictive language in their AC programs.

Ownership of off-site properties

Off-site projects may be located on public or privately owned land. Fee-in-lieu projects and developer constructed off-site mitigation projects are typically located on public property whereas off-site projects in credit trading programs are located on private property. A less common fee-in-lieu scenario involves a municipality using in-lieu fees to pay willing private property owners to allow municipalities to construct mitigation projects on their land (e.g., retrofit of existing SCMs, or purchase of easements and construction of new SCMs). Municipalities in the Central Coast Region may want to take advantage of mitigation opportunities on privately owned land if suitable public land does not exist within their jurisdiction. Older, existing development is not regulated under new and redevelopment requirements therefore retrofit implementation needs voluntary participation by property owners and financial incentives.

The Fifth and Fourteenth Amendments to the US Constitution prohibit the government from taking private property for public use without just compensation and due process of law (Parikh et al. 2007). Voluntary incentive schemes (funded by in-lieu fees) avoid these legal concerns and can encourage private property owners to retrofit existing developments (Roy et al. 2006; Parikh et al. 2007). Some fee-in-lieu programs use tax incentives to incentivize private land owners, for example, North Carolina's Ecosystem Enhancement Fee-in-lieu Program offers tax incentives for owners willing to grant easements on their properties and allow the agency to construct off-site projects (NCEEP 2012). Reverse auction bidding has been used to incentivize voluntary LID retrofits on already developed land and specifically to target neighborhoods in priority areas (Thurston et al. 2008). The bidding process identifies private land owners willing to participate in retrofit programs and the price they are willing to accept for municipalities to construct SCMs on their properties. A municipality or third party then ranks the bids and selects them according to price, thereby introducing a market-like competition. The selected retrofits can then be subsidized by a municipal fee in-lieu program. Refer to Box 8 for an example of LID retrofits performed in Shepherd Creek Watershed, Ohio, using reverse auction bidding.

Box 8: Watershed-scale stormwater retrofits using reverse auction bidding in Shepherd Creek Watershed, Ohio (Mayer et al. 2012).

A voluntary, economic incentive approach was used to implement stormwater management on private property in the Shepherd Creek Watershed (1.8 km^2) near Cincinnati, Ohio. In the pilot study, private land owners were engaged through a reverse auction bidding process to encourage placement of rain gardens and rain barrels on their properties.

To start the auction process, a preview mailing, auction package and bid form were sent to land owners. The incentive given to successful bidders was a one-time payment of their bid amount, a rain garden and up to four rain barrels for free, and three years of maintenance. It was assumed that the bid amount reflected a landowner's values, opportunity costs of dedicating their land to SCMs, and other nonmarket values.

At the end of the auction period, bids were evaluated based on a metric of effectiveness determined by dividing the total bid cost by a parcel-specific index of projected environmental benefit. The environmental benefits index (EBI) for rain gardens was based on the amount of potentially infiltrated runoff and proximity of the property to a stream channel. The EBI for rain barrels was based on the potential amount of water that would otherwise be lost to direct connection or conveyance to storm sewers. The resulting metric was ranked across bidders, and those with the highest scores (i.e., least cost and highest effectiveness) received storm-water management practices until project funds were exhausted (the retrofits could potentially be funded by in-lieu fees).

Two auctions held in 2007 and 2008 resulted in the installation of 83 rain gardens and 176 rain barrels onto more than 30% of the 350 eligible residential properties in the Shepherd Creek watershed. Bid requirements were relatively low. Nearly 55% of responders bid $0 for the rain barrels, which indicated that no-cost storm-water management installations and three years of maintenance constituted a sufficient incentive for the private property owners, and the average bid was $70 for rain gardens and $36 for each rain barrel. The decentralized practices made a small but statistically significant impact on watershed hydrology at the neighborhood scale.

Implementation deadlines

The time duration between an alternative compliance legal agreement and the actual implementation and completion of the off-site project varies by different programs and policies evaluated and the range of implementation deadlines is between two and five years. Schedule considerations may be influenced by the type of mitigation activities used in off-site projects. For example, some stormwater control measures function as designed immediately upon completion of the project. For others, such as LID bioretention SCMs, the system may not be fully functional until plants are established. In these cases trading ratios may be used to discount SCM performance until it's functioning as designed. To avoid a situation where full on-site impact is occurring but off-site performance is only partially mitigating the impact, more credits may need to be purchased from another off-site project.

The WQT policy recommends trading credits should not be used before the time frame in which they are generated (US EPA 2003):

"Credits should be generated before or during the same period they are used to comply with a monthly, seasonal or annual limitation or requirement specified in an NPDES permit. Credits may be generated as long as the pollution controls or management practices are functioning as expected" (US EPA 2003).

Federal guidance on in-lieu-fee arrangements for compensatory mitigation under Section 404 states off-site projects should be completed no later than two years following fee collection (ILF 2000). Trading ratios may be used to limit the generation of credits from an off-site location to account for lag time between the construction of development projects and completion of mitigation projects (ILF 2000):

"Land acquisition and initial physical and biological improvements should be completed by the first full growing season following collection of the initial funds. However, because site improvements associated with in-lieu-fee mitigation may take longer to initiate, initial physical and biological improvements may be completed no later than the second full growing season where 1) initiation by the first full growing season is not practicable, 2) mitigation ratios are raised to account for increased temporal losses of aquatic resource functions and values, and 3) the delay is approved in advance by the Corps." (ILF 2000).

Central Coast Region's proposed PCRs require off-site projects to be completed in 4 years from the date of occupancy of the on-site project, and up to 5 years with CCRWQCB approval (Appendix A). If allowable, municipalities may wish to use trading ratios to reduce the risk of inadequate mitigation from time lag between construction of an on-site project and fully functional off-site project, or require more off-site volume credits be purchased from another project, or establish more restrictive timelines than those outlined in proposed AC language.

Funding requirements

Adequate funding of AC programs is crucial to their success. Various elements should be considered when determining the cost for an individual AC project as well as programmatic costs of the agency (e.g., a municipality) establishing an AC program. Funds are required for design and construction of off-site SCMs, long term operation and maintenance costs, and transaction costs. While funding for AC programs can cover project design, construction, and operation and maintenance, often monies are only required for construction.

Parties involved in AC agreements (i.e., municipality, on-site and off-site property owners) will have different financial responsibility for construction and maintenance of off-site projects depending on the type of trading mechanism employed (e.g., fee-in-lieu, credit trading). Questions such as 'who pays' for funding off-site projects and 'how much' they pay are often complex as developers may not be the long term on-site property owner and there are equity concerns regarding their payment for multiple years of operation and maintenance. Additionally, in a municipal/developer agreement, the developer may not be responsible for the planning costs that the municipality must incur to locate a suitable site. AC programs incur transaction costs which are administrative expenses incurred by parties involved in AC agreements such as site identification, negotiation of trading agreement, demonstration of performance equivalency and monitoring costs. Transaction costs are the primary reason for trading program failure because the cost are generally not well known, they can reduce program efficiency and lead to financial failure (Landry et al. 2005).

Fee-in-lieu program entities can establish fees using different methods but most fees are a flat rate standardized per unit of trading currency (e.g., price of mitigation ($) per gallon of runoff mitigated). In-lieu fee structures are generally a function of the average cost (including operation and maintenance costs) of comparable off-site facility construction in the region in which the project is located (CSN 2011; ELI 2006). West Virginia stormwater guidance suggests selecting a 'typical' BMP on which to base payment-in-lieu fees or setting the fee based on a pre-established portfolio of off-site mitigation projects (WVDEP 2012). Fee-in-lieu programs may also base fee rates on the cost of on-site or off-site mitigation costs (CSN 2011). A report on redevelopment projects by Chesapeake Stormwater Network recommended that fees are based on the mitigation methods (credit generating activities) and type of land municipalities intend to employ (CSN 2011). Long established fee-in-lieu programs appear to have a better understanding of their costs which allows them to set fees based on local mitigation costs and project location. For example, Melbourne Water's stormwater quality offset program in Melbourne, Australia, has different in-lieu fee rates for each city suburb and the fee rate varies with local construction costs (MW 2006). Only one type of SCM (treatment wetland) is used in the program therefore construction costs are well known.

US Federal guidance on fee-in-lieu programs for wetland compensatory mitigation states:

"Funds collected should be based upon a reasonable cost estimate of all funds needed to compensate for the impacts to wetlands or other waters that each permit is authorized to offset. Funds collected should ensure a minimum of one-for-one acreage replacement, consistent with existing regulation and permit conditions." (ILF 2000).

Private entities establishing AC programs (e.g., privately owned mitigation banks, private brokers of stormwater 'credits') generally use a market-based approach to determine the price of the 'credits' they are selling. Some AC programs combine different funding mechanisms. For example, the new stormwater AC program in Washington D.C. has an in-lieu fee option as well as a retention credit trading option for the private market, and unused credits can be 'banked' similar to mitigation banking (refer to Box 9).

Box 9: Off-site retention options for regulated projects in the District of Columbia (DCGB 2012).

The District of Columbia has recently developed regulations that require regulated stormwater development sites to retain the first 1.2 inches of runoff and allow those sites the option to achieve a portion of that retention through off-site retention. A regulated site's options for achieving its off-site retention volume are the following:

- Use Stormwater Retention Credits (SRCs), each of which corresponds to one gallon of retention for one year; or
- Pay the District's in-lieu fee, the cost of which corresponds to one gallon of retention for one year; or
- A combination of the above.

Credit trading: DC is essentially completely built out and the retention credit trading program is expected to create a market for stormwater retrofits of existing impervious surfaces on privately owned property. To generate a credit, regulated projects are required to exceed the 1.2 inch retention standard. Unregulated sites such as older developments can generate a credit by achieving retention in excess of existing retention.

The District (or third party) provides the regulated site with contact information for SRC owners who wish to sell their SRCs. SRC buyers and sellers negotiate the terms of a transaction between themselves, but the transfer of SRC ownership is not complete until District has approved it. The use of a SRC is not restricted by watershed and a regulated site owner may purchase SRCs from the private market or generate them elsewhere. The District expects the cost of SRCs to be lower than its in-lieu fees, which may encourage trading on the credit market.

Lifespan: The one year lifespan of an SRC or in-lieu fee payment begins once it is used to satisfy an off-site retention volume. A regulated site may meet its off-site volume requirement for multiple years by paying sufficient in-lieu fees. Also, the District will certify up to three years' worth of SRCs for eligible retention capacity (the three-year period is based on the District's inspection cycle) and unused SRCs may be banked indefinitely. If in the future a regulated site retrofits and achieves its off-site volume on site, then it no longer must achieve that volume off site.

Assurances: The District certifies SRCs and eligible retention SCMs must pass a post-construction inspection and ongoing maintenance inspections, and the SRC generating site owner must provide a maintenance contract or agreement to insure ongoing maintenance. Once SRCs have been used or sold, they remain valid, even if the owner of the retention capacity for which SRCs were certified fails to maintain the retention capacity. However, these credit generating site owners are required to compensate for the associated retention failure by purchasing replacement SRCs or paying an in-lieu fee to the District.

The amount of funding required by entities establishing AC programs may depend on risks and uncertainties associated with allowed mitigation and legal and financial agreements are often put in place to ensure adequate maintenance and to protect against financial failure. Federal guidance (FED 1995) on mitigation banking states:

"The bank sponsor is responsible for securing adequate funds for the operation and maintenance of the bank during its operational life, as well as for the long-term management of the wetlands and/or other aquatic resources, as necessary".

"For projects to be permitted involving mitigation with higher levels of scientific uncertainty, such as some forms of compensatory mitigation, long term monitoring, reporting and potential remedial action should be required…The bank sponsor is responsible for monitoring the mitigation bank in accordance with monitoring provisions identified in the banking instrument to determine the level of success and identify problems requiring remedial action."

"The bank sponsor is responsible for securing sufficient funds or other financial assurances to cover contingency actions in the event of bank default or failure. Accordingly, banks posing a greater risk of failure and where credits have been debited, should have comparatively higher financial sureties in place, than those where the likelihood of success is more certain."

"Total funding requirements should reflect realistic cost estimates for monitoring, long-term maintenance, contingency and remedial actions. Financial assurances may be in the form of performance bonds, irrevocable trusts, escrow accounts, casualty insurance, letters of credit, legislatively-enacted dedicated funds for government operate banks or other approved instruments. Such assurances may be phased-out or reduced, once it has been demonstrated that the bank is functionally mature and/or self-sustaining (in accordance with performance standards)" (FED 1995).

The Central Coast Region's proposed PCRs include funding requirements for public and private off-site mitigation projects. For example, private off-site projects must transfer sufficient funding to a Permittee controlled escrow account or provide the Permittee with appropriate project bonding within one year of construction of the on-site project (Appendix A). However, the AC language does not specify funding mechanisms (e.g., in-lieu-fees, credit trading between private property owners, developer constructed off-site projects) for AC programs in the region.

3.0 Benefits and risks of alternative compliance approaches

3.1 Comparison of different funding approaches

Alternative compliance programs require mechanisms to fund off-site mitigation projects. Funding mechanisms define how AC agreements occur between parties (e.g., municipality, on-site property owner, off-site property owner) and the programmatic framework used to support the agreements. Three funding options most applicable to the municipal framework are in-lieu fee payment, developer constructed off-site mitigation, and credit trading, with fee-in-lieu being the most common approach. AC language in the Central Coast Region's PCRs (Appendix A) allows municipalities the flexibility to choose different funding options which may create opportunities for environmental benefits and cost efficiency but may also leave a municipality more vulnerable to environmental and socioeconomic risks. The following section compares the advantages and disadvantages of three different AC funding approaches, from a municipality's perspective.

In-lieu fee payment

The fee-in-lieu approach involves a developer or property owner paying a fee to a municipality, the monetary amount necessary for the municipality to provide a proportional share of runoff treatment off-site. The fee may be determined on a project-by-project basis or more typically, the municipality develops a flat rate fee (e.g., cost/gallon mitigated off-site) and applies the rate to each project. Municipalities use fees for site identification, design, construction, and operation and maintenance of off-site projects. Advantages and disadvantages of an in-lieu-fee approach include:

Advantages:

- The fee-in-lieu framework is flexible:
  - Municipalities choose the location of off-site projects and can strategically target priorities areas and community needs.
  - Municipalities typically locate off-site projects on publicly owned property but may also use collected fees to fund off-site projects on privately owned property (e.g., retrofits of existing development, refer to Box 8).
  - A municipality may tailor mitigation treatments to watershed needs (e.g., water quality and restoration goals).
  - A municipality may collect fees as a one-time payment or an annual payment.
  - In-lieu fees may be used for 1:1 mitigation or aggregate mitigation projects, and project size can be adapted to AC demand.

- Municipalities provide more reliable long term operation and maintenance of mitigation projects than on-site private property owners.

- A fee in-lieu program run by a municipality using publicly owned property diminishes transaction costs as the approach does not introduce additional trading participants into the equation (e.g. private property owners) and negotiations are minimal (Woodward and Kaiser 2002).

- Private property retrofits may produce net environmental benefits which may not otherwise be achieved by new and redevelopment on-site compliance.

- A flat rate fee reduces developers' uncertainty regarding stormwater management costs and assists project planning.

- An in-lieu fee approach may lead to quicker approval of development projects (CSN 2011).

Disadvantages:

- Identification of suitable mitigation sites and project design are municipal responsibilities which increase municipal costs and administrative burden.

- Once a fee is paid, the on-site property owner has no further responsibility for the off-site mitigation. Municipalities take on liability for mitigation compliance and cost of operation and maintenance of off-site projects.

- It may be difficult for a municipality to estimate fee rates, especially if many types of mitigation can be utilized and local SCM costs are not well known. Municipalities increase financial and compliance risk if their in-lieu-fees underestimate project costs and consequently underfund projects.

- Fee-in-lieu projects are generally not implemented in advance of on-site impacts. There is potential for delays if municipalities do not have an inventory of projects ready to be implemented when the opportunity arises. Delays may lead to inadequate mitigation of on-site impacts, and financial and compliance risk if the off-site project is not completed by the implementation deadline.

Developer constructed off-site mitigation

Under this AC option, a developer or on-site property owner is responsible for the construction of an off-site project to meet their off-site mitigation compliance requirements. An off-site project may be constructed on private or public property however projects located on private property require the owner of the land to accept liability and ongoing operation and maintenance associated with the project (Winer-Skonovd and Bliss 2012). Developer constructed off-site mitigation on public property is a more viable option. Advantages and disadvantages of this approach include:

Advantages:

- Municipalities do not pay for the construction of off-site projects.

- Off-site compliance costs (i.e., cost per gallon of runoff mitigation) may be less than the costs of on-site compliance.

- Developers or property owners will likely construct off-site projects close to their on-site project (e.g., public right-of-way adjacent to regulated project). Locating off-site projects close to the on-site project may reduce risk of 'hot spot' development, inadequate mitigation, and social equity issues.

- Construction of an off-site project could occur at the same time or soon after construction of the on-site project, reducing the risk of time lag between on-site impact and off-site mitigation.

Disadvantages:

- Developers or on-site property owners may have difficulty identifying feasible off-site locations and designing projects on publicly owned land. Municipalities may have to assist them and bear costs of site identification and project design.

- The developer or on-site property owner may not properly construct the off-site project, increasing the risk of inadequate off-site mitigation.

- Small 1:1 mitigation projects are likely to be constructed under this AC approach. These may not be as effective and cost efficient as larger aggregate mitigation projects.

- Municipalities are responsible for operation and maintenance of off-site projects on public land. Many small off-site projects would create a large maintenance burden for a municipality.

Credit trading

Under this AC option, a developer or property owner purchases stormwater 'credits' through a private seller. The Washington D.C. stormwater retention credit trading program is an example of a credit trading approach (refer to Box 9). In a credit trading scenario, developers or on-site property owners are 'credit buyers', off-site private property owners willing to sell their excess runoff reduction treatment (i.e., beyond the MEP standard) are 'credit sellers', and a third party 'private seller' assists the trade and reports to the municipality when the trade is complete. A private seller can be a company selling credits for profit or a non-profit group (e.g., watershed group, land trust) and may have different roles and responsibilities depending on the type of credit trading framework (e.g., credit exchange, credit market, credit banking). For example, a private seller may be a credit broker (brokers bring prospective traders together and negotiate trades between credit sellers and credit buyers) or a credit aggregator (credit aggregators buy credits from credit sellers and resell credits in a private market). Mitigation banks are also private sellers however they typically purchase private land or easements, complete projects and then sell credits. Advantages and disadvantages of a credit trading approach include:

Advantages:

- The private seller takes on the liability of the off-site compliance including the operation and maintenance of projects therefore credit trading is potentially a low cost AC option for municipalities.

- Off-site projects are typically constructed in advance of credit generation thereby reducing the risk of time lag between on-site impact and off-site mitigation.

- Completed projects that have not yet had credits purchased for off-site mitigation can act as a margin of safety against other mitigation project failures.

- Private sellers have the ability to independently raise capital and can potentially conduct larger (i.e., aggregate mitigation), more land intensive, and costly projects such as large restoration and preservation projects.

- Credit prices are more likely to capture the true cost of mitigation activities in specific locations than a fee estimate from a municipality. Trading participants can potentially capitalize on the biophysical heterogeneity (e.g. variations in slopes and soils) within a watershed and the resulting cost differential between mitigation projects in different locations, and this may improve the long term efficiency and cost effectiveness of mitigating runoff impacts. For example, development sites that face higher runoff control costs can meet their regulatory obligations by purchasing credits from another site at lower cost (Parikh et al. 2005; Selman et al. 2009; Thurston et al. 2003). Competition between off-site owners (e.g. market forces) could further reduce mitigation costs and drive innovation.

- The possibility of earning revenue from selling excess runoff reductions may provide property owners with an incentive to build SCMs with greater capacity than the minimum regulatory requirement which may help achieve water quality goals more quickly (Thurston et al. 2003). Private property retrofits may produce net environmental benefits which may not otherwise be achieved by new and redevelopment on-site compliance. For example, credit trading between new development and existing urban development, or new development and agricultural land (e.g., credit generation from riparian buffer restoration).

Disadvantages:

- Municipalities cannot control and target investment in strategic areas.

- Municipalities must approve, oversee and track credit trading because they maintain compliance liability under the stormwater Permit. Mitigation projects may also require monitoring to reduce compliance risk. For example, the District of Columbia's trading program will require the District's Department of Environment to inspect and certify mitigation activities every three years to ensure proper operation and maintenance (DC 2012).

- The credit trading approach requires a high demand for off-site compliance from credit buyers and willing property owners to sell credits. A large and sustained supply and demand for trading is required for private seller participation. Without third party private sellers, high transaction costs will discourage direct trading between buyers and credit sellers.

- Municipalities may be required to assist third party private sellers with identification of off-site projects and fostering credit markets. For example, the District of Columbia's Department of Environment is developing an online trading service with their trading program whereby trading participants (i.e., on-site and off-site property owners) can advertise their request for mitigation projects or their projects for purchase (DC 2012).

<u>Summary of the different funding approaches</u>

The three AC funding options most applicable to the municipal framework (in-lieu fee payment, developer constructed off-site mitigation, and credit trading) are summarized in Table 1.

Table 1: Comparison of different funding approaches for AC programs. The developer or on-site property owner relinquishes liability for their off-site project when they pay an in-lieu fee or purchase credits from a private seller. The liability for developer constructed projects on public land shifts to the municipality post-construction.

Off-site mitigation options	**Ownership of off-site property**	**Responsibility for construction**	**Responsibility for maintenance**	**Example**
Pay in-lieu fee	Public	Permittee	Permittee	Municipal fee-in-lieu program utilizing public land.
	Private	Permittee	Permittee/ Property owner	Residential retrofit program funded by in-lieu fees.
Developer mitigates off-site	Public	Developer	Permittee	Developer constructs SCM in public right-of-way.
Purchase credits through a private seller	Private	Private seller	Private seller	Developer purchases stormwater credits from a private mitigation bank or credit broker.

Each funding option gives participants in the AC agreement (i.e., municipality, developers, on-site and off-site property owners, third parties) different financial responsibilities such as project construction and long term maintenance but in all cases the Permittee (usually a municipality) is liable for non-compliance under their stormwater NPDES permit for post-construction requirements. Contracts and financial assurances may be used by participants to protect themselves from legal and financial risk in case responsible parties fail to maintain the mitigation project or deliver the agreed upon amount of runoff mitigation on schedule.

AC programs may use a combination of funding options to maximize advantages and minimize disadvantages. For example, the Washington D.C. program combines the flexibility of in-lieu fees with a credit trading option, and the market approach is expected to lower compliance costs (refer to Box 9). A common combination is in-lieu fees and credit banking because the advance construction (i.e., prior to impacts) of credit banking projects can act as a margin of safety against potential project delays and failures. For example, The City of Seattle alternative compliance language includes options for their agencies to use mitigation banking and fee-in-lieu payment to compensate for stormwater impacts (Sharpley 2011).

Municipalities in the Central Coast Region are typically small and the role of a municipality in an AC program and its ability to implement different funding approaches may be influenced by program costs, staffing and expertise required as well as developer needs and demand for AC, willingness of private property owners to participate, and risks and uncertainties associated with off-site projects. The participation of third parties alters the partition of transaction costs and influences cost efficiency in AC programs (Woodward and Kaiser 2002). For example, to reduce administrative burden and transaction costs in a fee-in-lieu program, a municipality might form partnerships with third parties (e.g. other government agencies and non-profit organizations such as conservation agencies, watershed organizations and land trusts) well placed to identify appropriate mitigation sites and broker and administer trades. For instance, a municipality could partner with a land trust to acquire conservation easements on properties in groundwater recharge areas or work with a watershed organization to prioritize mitigation projects. The role of a municipality might also be influenced by private mitigation banks operating within its jurisdiction. In terms of credit trading, small municipalities are unlikely to have a large and sustained supply and demand for AC within their jurisdictions and watersheds therefore private sellers may be unwilling to participate in credit trading due to the financial risk of recouping costs of a trading service. A regional scale effort from municipalities or other government agency to develop an online trading platform may help increase feasibility of credit trading and reduce overall costs.

The focus of the next sections is on in-lieu fee programs because the in-lieu fee funding approach provides the most flexibility and is often used by municipalities in existing AC programs.

3.2 Factors influencing benefits and risks of fee-in-lieu programs

The benefits and risks of fee-in-lieu programs depend on many factors including the scale of the program and projects, timing and location of projects, type of mitigation activity allowed by a program, method of determining fees, and fee schedule.

Scale of mitigation projects

Alternative compliance for new and redevelopment projects can be achieved through 1:1 mitigation where an off-site project addresses on-site compliance only (e.g. a project hydraulically sized to control an equivalent quantity of runoff) or with aggregate mitigation where an off-site project may address multiple on-site compliance projects (e.g. a regional project that collects runoff from multiple on-site projects). The scale of off-site projects, 1:1 or aggregate mitigation, can affect the benefits and risks of fee-in-lieu programs.

On the one hand, aggregate projects may have more environmental benefit due to the greater geographic scale of mitigation. For example, space intensive but superior technologies such as biologically-orientated systems (e.g. bioretention swales) could be used to treat volume and improve quality of runoff rather than multiple isolated small-scale projects (Maupin and Wagner 2003). By consolidating piecemeal mitigation projects aggregate mitigation can secure a range of environmental benefits such as development of large restoration/preservation areas that support riparian connectivity or purchase of easements to protect groundwater recharge areas. An advantage of regional facilities is that they treat existing runoff as well as runoff from new developments and therefore can be more protective (Maupin and Wagner 2003).

On the other hand, 1:1 mitigation projects are typically smaller than aggregate projects and more aligned with the principles of LID where decentralized, small-scale designs are emphasized. The foundation of LID is that stormwater is best managed at the source and directing mitigation to an aggregate project such as a regional facility goes against this decentralized approach of restoring and protecting hydrological processes. Also, pollutant removal and infiltration efficiency can often decrease with larger facilities. However there may be examples of aggregate mitigation where larger facilities are consistent with watershed processes. For example, in some areas of the Central Coast Region, existing networks of infiltration basins may already be in alignment with watershed processes protection objectives by allowing groundwater recharge in a cost-efficient manner (Inglis 2012). While the decentralized approach is preferred, in this situation it is not necessary because infiltration is recharging the same groundwater aquifer and it does not matter whether stormwater enters the aquifer through a large aggregate mitigation project or many smaller 1:1 mitigation projects.

There are economic tradeoffs for large and small scale mitigation projects. Aggregate mitigation projects can take advantage of economies of scale to increase cost effectiveness and efficiency. The larger size of aggregate projects may improve cost efficiency as municipalities could allocate staff to maintenance of a few public facilities rather than to inspection and enforcement of multiple private facilities (Maupin and Wagner 2003). Aggregate mitigation projects can bring together financial resources, planning, and scientific expertise not practicable for smaller scale mitigation projects. However, the operational risk associated with larger aggregate projects is greater than 1:1 mitigation projects because if it fails the consequences can be more significant than failure of one small system. 1:1 mitigation projects have other advantages, for example, smaller projects are easier to locate within space-constrained urban areas (e.g. public right-of-ways). The timing of 1:1 mitigation project implementation is more predictable than aggregate mitigation as no waiting is required to collect fees from multiple development projects. A project's size may also affect CEQA requirements. A larger project might trigger the need for environmental impact assessment and lead to delays and increase transaction costs (e.g. more data collection and administrative burden).

Timing of projects

Municipalities may choose to construct off-site projects in advance of in-lieu fee collection or more typically, municipalities may construct projects after they collect fees from on-site owners. Timing of off-site projects is important because alternative compliance language in post-construction requirements contains deadlines for the completion of off-site projects, and the time interval between on-site impact and off-site mitigation influences both environmental and financial benefits and risks of off-site projects.

Constructing an off-site project after fees are collected from developers may result in a delay or 'time lag' between on-site impact and off-site mitigation. This time lag increases the risk of inadequate mitigation and environmental impacts as well as financial and compliance risks. For example, if a municipality accepts in-lieu fee payments to construct a regional off-site project but is unable to construct it within an allowed time frame, the municipality risks being out of compliance and may have to refund the money (Maupin and Wagner 2003). Aggregate projects are a greater financial risk as the projects are typically larger and more costly than 1:1 projects and there is likely to be a longer lag time between multiple on-site impacts and collection of funds necessary for an aggregate off-site mitigation project. Additionally, there is normally a period of time between the completion of the off-site project and SCMs becoming fully functional and this lag time may be significant for SCMs that rely on vegetation for runoff treatment, particularly if construction of off-site projects and planting vegetation occurs after on-site impacts begin. AC programs sometimes use trading ratios to resolve time delays (i.e., requiring more mitigation to account for lag time) however estimation of trading ratios increases transaction costs and may reduce cost efficiency of AC programs.

Advance identification of off-site locations that meet basic technical and site criteria and project planning by municipalities may reduce time lag between impact and mitigation. Planning ahead can avoid the scramble to identify workable sites and implement projects within the allocated time period and may allow municipalities to integrate comprehensive community greening objectives (Inglis 2013). Advanced planning would require municipalities to fund planning work before in-lieu fees are collected however construction of projects in advance would require more funds and financial risk.

Constructing an off-site project in advance of on-site impact reduces the risk that alternative compliance will lead to net reductions in environmental quality as there is no time lag between on-site impact and off-site mitigation. Off-site projects completed in advance may also reduce compliance risk because they can be used as a safety mechanism against off-site project failure at other locations. Another advantage is that municipalities will know the cost of off-site project construction and can therefore more accurately estimate fee payments and reduce the risk of underfunding projects. However, municipalities may not have available funds to construct off-site projects prior to fee collection and if they do, AC demand is difficult to predict and municipalities may not be able to collect fees to recoup project costs if AC demand is low.

Location of projects

Municipalities are responsible for identifying off-site locations in fee-in-lieu programs and the selection of locations influences the benefits and risks of their programs. Physical characteristics of off-site locations as well as property ownership and jurisdiction may affect the cost and effectiveness of mitigation at off-site locations. Also, municipalities take on the responsibility for managing the risks associated with changing the location of compliance and the 'equivalency' of the on-site impact and off-site mitigation is influenced by the off-site location.

Physical characteristics of off-site locations such as soil type and slope may affect retention gains, space requirements, and cost of off-site projects. For example, most infiltration SCMs are not recommended on low infiltrative soil types C and D or steep slopes, and more expensive mitigation treatments may be required at these locations. Challenging locations may increase design costs and reduce off-site location availability and project feasibility. However, if a mitigation cost differential exists across parcel owners in a watershed (e.g., due to variations in soil or slope) then potential cost savings can be realized through compliance at off-site locations with lower mitigation costs (e.g., high infiltrative soil types A and B, flat land). Off-site mitigation could potentially be more cost efficient than on-site compliance if off-site compliance costs (plus transaction costs) are less than on-site compliance costs.

Municipalities take on the responsibility for managing risks associated with changing the location of compliance such as the risk of untreated impact at the on-site location. A concern with any offsite mitigation is the possibility of localized impacts, called 'hotspots'. For example, an unmitigated on-site project may cause a stream bank erosion hotspot downstream of the development. These risks may decrease if the off-site location is in close proximity to on-site location. To avoid localized impacts most alternative compliance programs limit the size of the geographic area in which the offsite mitigation must occur, such as within the same sub-watershed or drainage, to ensure there is a linkage between where the development impact occurs and where it is mitigated. This also reduces availability of off-site locations. To allow the most flexibility, another approach uses trading ratios so that as the distance between the development and offsite project increases, additional off-site mitigation needs to be purchased. By making the off-site mitigation more expensive, this creates an incentive to locate the offsite projects in closer proximity to the development (Morrison 2002). However the use of trading ratios may increase the administrative burden and transaction costs of AC programs. Another risk associated with changing the location of compliance is the redistribution of resources and social inequities. For example, wetland banking can facilitate the redistribution of wetland resources from urban to rural areas, taking with them important ecosystem services that wetlands provide to urban communities (Ruhl and Salzman 2006). AC projects in the Central Coast Region are not required to be located within the same WMZ as the regulated project (Appendix A). This may increase the availability of off-site locations and municipal flexibility but also increases the risk that off-site projects will not maintain watershed processes.

The 'equivalency' of an on-site impact and off-site mitigation is typically quantified using the trading currency units (e.g., runoff volume) however it is also influenced by characteristics of on-site and off-site locations such as relative positions in the watershed, environmental sensitivity, and pollutant loadings. Most stormwater AC programs treat each gallon of runoff mitigation equally no matter what the location. This approach has less administrative burden but does not account for the many differences in locations (e.g., ecosystem services) that may affect the potential of AC to achieve net environmental benefits and/or contribute to the risk of inadequate mitigation. For example, net environmental benefits may be built into a trade design through trading ratios or may occur when trading between locations involves different pollutant loadings. For instance, an onsite housing development offsets an impervious area by installing pervious pavement in an offsite parking lot. The trade may mitigate the same runoff volume but also result in net water quality benefits due to reduction of overall pollutant loads. Also, an off-site location near a stream may have more water quality benefit than an offsite further away but their runoff reduction value may be identical. Off-site mitigation may improve water quality faster than would otherwise occur through onsite compliance and municipalities that account for differences in locations can prioritize projects with multiple benefits. On the other hand, it may be difficult to account for location influences that may increase environmental risks. For example, uncertain local and watershed scale effects including mixing of upstream/downstream nutrient loads may lead to unintended consequences such as blue green algae out breaks. It may be wise for municipalities to exclude sensitive areas from potential off-site locations to reduce environmental risks. Regulatory programs such as 303(d) listed impaired water bodies with Total Maximum Daily Load (TMDL) allocations and anti-degradation regulations for high quality waters (SWRCB Resolution No. 68-16) may further reduce the availability of locations for off-site projects (DEQ 2009; SWRCB 2004).

To achieve net environmental benefits, some AC programs use fees to target high priority retrofits and restoration projects in their watershed. For example, many communities would like to see street landscaping to enhance existing highly urban areas of their community but have no money to implement (Inglis 2013). By planning the locations of off-site projects, AC dollars can be used to fulfill multiple objectives including stormwater mitigation, greener communities, improved streets, enhanced economic vitality, and green infrastructure networks (Inglis 2013). However care must be taken to ensure that targeting these locations does not lead to inequities in the community. For example, proximity to off-site projects such as green street programs in public ROW may improve local property values while other property owners may be adversely impacted by proximity to on-site locations where runoff impacts have not been mitigated (e.g., localized flooding issues).

Ownership of off-site locations and the jurisdiction in which they are situated may also affect the benefits and risks of fee-in-lieu programs. For example, off-site projects on publicly owned property are typically less costly to implement than off-site projects on privately owned property because they are controlled by the municipality and AC agreements do not require negotiation with other parties or land/easement purchases. Off-site retrofit projects on privately owned land improve the status quo situation but require a municipality to pay for construction of projects as well as owners opportunity costs (i.e., price they're willing to accept for relinquishing development at the treatment location) and are not feasible if willing property owners cannot easily be found (e.g. transaction costs may be too high if lengthy search and negotiation is required). Municipalities may not have jurisdiction in parts of the watershed (e.g., upper watershed) where off-site projects can have the most benefit and cost effectiveness. For example, jurisdictional boundaries within a watershed (e.g., City and County), differences in land use regulation (e.g., urban and agricultural land), and jurisdictional gaps between MS4 and NPDES permits may limit the availability of off-site locations and constrain AC implementation. Municipalities may find more suitable off-site locations (e.g., multiple benefits, cost effective) outside their jurisdiction however locating off-site projects outside a municipality's jurisdiction may result in mitigation monies leaving the community or watershed where they were paid and may result in higher transaction costs (e.g., administrative burden of negotiating AC agreements with another jurisdiction).

Allowed mitigation types

Selection of SCMs for fee-in-lieu programs is typically based on the potential of SCMs to achieve multiple benefits at low cost. Municipalities can tailor their SCM selection to their watershed and community needs however different mitigation types have different benefits and risks and the selection process may require cost-benefit tradeoffs. Municipal considerations may include in-kind and/or out-of-kind mitigation types, cost/benefit criteria, and the level of uncertainty and risk they are willing to accept.

The types of mitigation treatments allowed in an AC program should reflect the program's trading currency (e.g., runoff reduction) and stipulations. SCMs are typically assigned runoff reduction and/or pollutant reduction credit in stormwater AC programs. AC language for the Central Coast Region (Appendix A) states that even if volume is controlled off-site, developers still need to mitigate water quality on-site to the extent feasible (this does not apply to on-site projects which demonstrate technical infeasibility). Pollutant reduction is a stipulation for using

AC therefore will not be given 'credit' in Central Coast AC programs. Many SCMs mitigate for runoff volume and water quality (refer to Table 2) therefore developers could potentially pay twice for mitigating water quality (at both on-site and off-site locations). This may result in net environmental benefits but could also reduce cost savings of AC programs and lead to inefficiencies.

Table 2: Comparison of runoff reduction and pollutant reduction capabilities of a selection of stormwater control measures.

Stormwater Control Measures	Mitigation type	Runoff reduction	Pollutant reduction
Permeable pavement	Infiltration	✓	✓
Vegetated swale	infiltration	✓	✓
Stream buffer	infiltration	✓	✓
Bioretention cell	bioretention	✓	✓
Tree planting	infiltration	✓	
Green roof	evapotranspiration	✓	
Rain barrels	rainwater harvesting	✓	
Constructed wetland	biofiltration		✓
Detention pond	detention		✓

To reduce the risk of undermining environmental benefits of the Central Coast's PCRs it may be beneficial for off-site mitigation activities to fit with the CCRWQCB's over-arching watershed management strategies (i.e., LID, WMZs) even though it is not a requirement in the AC language. For example, a municipality with a WMZ requiring runoff retention via infiltration may want to only allow off-site mitigation activities such as bioretention swales and pervious pavement rather than SCMs that capture runoff (e.g. rainwater harvesting, rain barrels) or promote evapotranspiration (e.g. green roofs, rain gardens). LID control measures are required in the PCRs to help restore pre-development hydrology and decrease pollutant loads via filtration and biodegradation. Implementation of AC mitigation activities with widely distributed benefits (e.g., groundwater infiltration in a recharge area, tree planting) are compatible with the decentralized approach of LID. However, these infiltration mitigation activities may not target priority projects in the watershed. For example, a municipality may want to use fee-in-lieu payments to fund 'out-of-kind' mitigation activities (i.e., activities which cannot be easily or directly linked to the trading currency) such as stream restoration needs (refer to Box 5).

There are benefit and risk tradeoffs with allowing 'out-of-kind' mitigation activities in AC programs. Out-of-kind activities such as stream restoration may fit with a municipality's broader watershed management goals and priorities but establishing equivalency with on-site impacts is more difficult because simple algorithms typically do not exist to easily translate the activities into runoff reduction units. Translation metrics may need to be developed if they are not available or established metrics are not suitable for local climate (e.g., metrics developed for East Coast conditions may not be appropriate for West Coast conditions). Out-of-kind trades may require extra precautions such as assignment of trading ratios (e.g. a trading ratio of more than 1:1 requires more mitigation) and other margins of safety (e.g. more monitoring of off-site projects) to compensate for increased uncertainty of mitigation. Trading ratios can provide a margin of safety for the environment but setting high ratios also reduces the economic benefits of trade (Randall and Taylor 2000). Out-of-kind activities could provide a municipality with a means to focus efforts on those most crucial to their watershed health however it could also be a venue for abuse and inadequate mitigation. For example, in the early days of wetland mitigation programs in the U.S. the use of crude formulas led to the replacement of important wetland function with larger areas of less valuable wetlands (Salzman and Ruhr 2000). Also, trading ratios used in stream mitigation banking are found to be problematic because they're based on geomorphic stability metrics rather than lost ecological function (Lave et al. 2008). The degree of uncertainty in establishing 'out of kind' SCM effectiveness also increases a municipality's legal risk. For example, maintaining compliance with water quality criteria at all times may be difficult to prove and pose an unacceptable liability risk for NPDES permittees. AC programs may also draw legal challenges. For example, municipalities could be liable under the Endangered Species Act for failure to regulate strictly enough if alternative compliance programs are not equally protective of the environment (e.g., salmon and steelhead habitat) (Maupin and Wagner 2003).

Runoff treatment costs of mitigation activities may influence the effectiveness and efficiency of fee-in-lieu programs. For example, fee-in-lieu programs in small municipalities with little demand for AC projects may not be able to raise funds for costly mitigation activities such as purchase of easements or development rights. Municipalities will want to put limited stormwater management dollars to effective use and, depending on their watershed and community needs, may need to make trade-offs between expensive mitigation activities with multiple long term benefits (and potential net environmental gains) and less expensive mitigation activities with limited benefits. For example, a municipality might use in-lieu fee payments to retrofit public ROW with bioretention SCMs as part of a green streets program. This off-site mitigation activity may have multiple benefits including improved flow control, water quality and neighborhood aesthetics that might not be achievable at the on-site location however street retrofits typically costs more (per runoff volume treated) than other off-site mitigation activities. For instance, detention ponds are one of the least expensive mitigation activities (per runoff treated) but do not have the multiple benefits of retention based systems, such as water quality treatment.

A key point is that mitigation activities for fee-in-lieu programs should be well understood in terms of costs and effectiveness in order to quantify their mitigation (e.g. to assess mitigation performance) and determine in-lieu fee structures. Municipalities need to consider differences in operation and maintenance costs, reliability, and life span of activities. Some mitigation activities, for example rainwater harvesting, may have a longer life span and less maintenance burden than other activities such as bioswales, which require maintenance of vegetation to remain effective. Municipalities with in-lieu fee programs are financially responsible for mitigating stormwater impacts at the off-site location in perpetuity (or for the duration of the on-site impact) therefore they will incur further costs if mitigation activities are no longer effective and need to be replaced.

Operation and maintenance of off-site projects

Off-site projects must be well maintained in order to achieve expected performance standards and the party responsible for operation and maintenance will affect the benefits and risks associated with the projects. The responsibility for operation and maintenance of off-site projects in a fee-in-lieu program typically falls on the municipality in charge of the program however private property owners or other municipalities may take on the responsibility for some projects.

Municipalities are typically responsible for the operation and maintenance of off-site projects located on public lands within their jurisdiction. A watershed approach may lead to projects outside municipality jurisdiction and require maintenance agreements with other jurisdictions for long term maintenance assurance. In some cases a municipality may also agree to maintain off-site projects on private property (e.g., residential retrofits) to incentivize private owners to implement projects on their property. A project that is not well maintained will not successfully mitigate the runoff reduction value assigned to it. For this reason it is essential that municipalities establish performance standards, performance measures and monitoring criteria to ensure project success (WVDEP 2012). Municipalities provide more reliable operation and maintenance than private property owners and a municipality can monitor and inspect projects during maintenance. Municipalities may reduce maintenance costs if projects are located in public areas already maintained by the municipality. However, operation and maintenance costs of off-site projects may be a significant financial burden to municipalities, particularly for many small projects. Municipalities need to incorporate full operation and maintenance costs (including full replacement costs depending on the SCM) into in-lieu-fees otherwise they will not be able to recoup the costs.

Property owners are typically responsible for the operation and maintenance of off-site projects on their property. Property owners may also agree to take responsibility for operation and maintenance of green street projects in public ROWs adjacent to their properties. Municipalities may reduce AC costs if private property owners maintain off-site projects. However municipalities will need to educate property owners on proper maintenance procedures to ensure effectiveness and reliability of mitigation activities as SCMs can create problems if improperly maintained (e.g., bioswales rely on maintaining vegetation for effective infiltration). Legal agreements between a municipality and private property owners are typically required to insure long term maintenance and reduce financial risk (e.g., an escrow agreement with the municipality to be used in case of bankruptcy).

Program scale
Municipalities in the Central Coast Region may administer fee-in-lieu programs on a site-by-site basis or use a larger scale watershed planning approach (e.g., watershed plan, regional plan) and the scale of a program will influence its benefits and risks.

A site-by-site scenario involves a municipality collecting a fee payment from a developer and determining the next off-site project based only on the runoff reduction requirements of its associated on-site project. The approach minimizes administrative burden and is less complex than developing a watershed plan because projects are not considered in the context of other projects and are likely to be limited to 1:1 mitigation within a municipality's jurisdiction. A site-by-site approach may be suitable for municipalities with low AC demand (e.g., occasional 'one off' projects due to technical infeasibility) however it could miss potential opportunities for AC projects to achieve multiple environment and community benefits and may result in isolated projects with little connection to the surrounding watershed.

A watershed planning scenario involves a municipality incorporating a portfolio of off-site projects into a larger watershed or regional plan, and fees collected from developers may be pooled and used to fund 1:1 or aggregate projects. This programmatic approach facilitates strategic planning beyond the parcel level, integrated watershed management, and synergy with other ecosystem services for multiple benefits (Maupin and Wagner 2003). A watershed planning approach may be used to address priority areas in a watershed and as a platform for working with and coordinating with other agencies beyond a municipality's jurisdiction for potentially more effective and cost efficient projects. For example, neighboring Cities and Counties may coordinate and combine in-lieu fees received from developers under a Joint Powers Authority (JPA) to assist development of off-site projects involving large scale planning such as smart growth strategies, urban and open space planning, water quality and restoration projects. The watershed planning option in the Central Coast's PCRs does not require developers of on-site projects to prove technical infeasibility and can take advantage of locations in a watershed, outside a municipality's jurisdiction, with lower mitigation costs. However the approach has more administrative burden and may be most suitable for municipalities with moderate to high demand for AC. Also, it may be difficult to assess cumulative risks of large scale implementation of off-site projects. If a watershed plan is established to address impairments at the watershed scale, care must also be taken to assure that AC does not contribute to the impairment of local watersheds at a smaller scale (e.g., drainage scale).

Method of fee determination
In-lieu fees may be determined on a project-by-project basis or more typically, the municipality develops a flat rate fee and applies the rate (e.g., cost/gallon mitigated off-site) to each project. Each approach has different methods to determine fees and there are benefits and risks associated with each method.

Municipalities can base their flat rate fee on the cost to establish a 'typical' SCM in their jurisdiction. For example, West Virginia's off-site mitigation guidelines recommend setting in-lieu fee payments based on the cost per gallon of runoff mitigated by a bioretention retrofit project with a one acre drainage area and Class C soils (WVDEP 2012). The 'typical' fee rate is used as a proxy for implementing a wide variety of off-site mitigation projects even if the actual cost of off-site projects are higher or lower than the 'typical' off-site project. Off-site project costs are highly variable due to different SCMs, site characteristics and economies of scale, and the 'typical' SCM approach does not account for this variability. The main risk of this approach is that the majority of off-site projects may turn out to be more costly than the 'typical' SCM, in which case municipalities will not be able to collect enough funds to fully cover the cost of off-site mitigation and may require supplemental public funding to maintain compliance. A benefit of estimating a flat rate fee is that developers will know their costs in advance and can make informed decisions on which option to pursue, either pay the in-lieu fee or adapt the on-site project to mitigate more runoff.

Fee estimation using the 'typical' SCM fee approach may be influenced by expected level of development activity, development intensity, retrofit opportunities, and land prices. Fees are often levied too low when they're based on SCM costs at new development sites rather than mitigation locations with higher unit costs (CSN 2011). For example, LID retrofits in public right-of-ways commonly have a higher unit cost than LID implementation at a green field development (CSN 2011). One of the lowest fee options is the price of building storage retrofits (e.g. enlarging detention ponds) or stream restoration projects on public land. This option works best for larger counties with moderate development intensity and abundant retrofit opportunities but is not recommended for larger cities that often lack abundant and cheap storage retrofit opportunities (CSN 2011). A more expensive option is to base fees on the cost of green street retrofits. This option may make sense for cities with high development intensity, high land prices and high rate of future redevelopment activity (CSN 2011). The fee should be reasonably equitable, high enough to encourage designers to incorporate innovative practices into their on-site projects but not so high that it will place undue burden on developers or so low that it undercuts the cost of full LID compliance at new development sites (CSN 2011).

Another flat-rate fee estimation approach is for municipalities to base their fee on the average cost of a pre-established portfolio of off-site mitigation projects. Planning mitigation projects in advance would require municipalities to expend resources to identify potential sites, plan and design projects in advance of fee collection but may allow municipalities to integrate projects into watershed planning objectives. This approach is likely to best represent actual mitigation costs, particularly if only a few different types of SCM are used in the program, and the closer the fee is to the actual mitigation cost plus transaction cost, the more cost efficient the fee in-lieu program. The common challenge in both methods of fee estimation is that municipalities have limited local SCM cost information. SCM construction costs are notoriously variable due to complexity and site conditions. Less is known about other cost categories such as project design, program overhead cost, and long term operation and maintenance cost, and most studies do not directly estimate but express these costs as a percentage of construction costs therefore considerable uncertainty exists with setting a fee rate (WVDEP 2012).

Alternatively, municipalities can determine in-lieu fee payments on a project-by-project basis. This approach does not require municipalities estimate a fee rate, instead the fee developers pay varies for each project. Under this scenario the fee amount might be determined by the construction costs of an on-site project. For example, in Santa Clara Valley hydromodification management plan, full implementation of compliance requirements is considered impracticable if the combined construction costs of required stormwater treatment and flow control measures exceeds 2% of the project cost (excluding land costs) (SCV 2005). If a developer demonstrates that their compliance costs exceed the 2% 'cost cap' criterion, the developer may instead contribute to an alternative compliance project up to a maximum of 2% of the project costs (SCV 2005). This fee in-lieu method does not require the municipality to estimate fees or equivalency between onsite impact and offsite mitigation since the fee is based solely on avoided onsite costs. But this method may leave offsite projects with inadequate funding and increase risk of financial failure because it does not account for offsite mitigation costs. This approach is inequitable because developers or off-site property owners pay different in-lieu fee rates (cost per gallon of runoff mitigated). It also has a high risk of inadequate mitigation of on-site impact because the fee amount is not necessary proportional to the runoff mitigated at the off-site project. A potential advantage of the 'cost cap' method is that it could be used by municipalities as cost criteria for establishing MEP treatment implementation standards at on-site locations.

Fee schedule

In-lieu fees are typically collected from developers as a one-time payment. Fees may also be collected in annual payments, as illustrated by the District of Columbia's AC program (refer to Box 9). A municipality's choice of fee schedule will affect the socioeconomic benefits and risks of their fee-in-lieu program. The one-time payment option represents the life cycle cost of an off-site project in perpetuity and when a developer or on-site property owner pays the fee the on-site property owner (and future owners of the property) has no further financial responsibility for off-site mitigation. In contrast, the annual payment option represents the life cycle cost of an off-site project amortized over a project's life span and the on-site property owner is financial responsible for annual payments to the municipality.

Annual payments are a more equitable option for property owners because future on-site property owners also bear the cost of their property's off-site mitigation requirements (rather than the initial owner paying the full mitigation fee including long term maintenance costs). The annual payment option has potential to encourage innovation as future on-site property owners can choose to retrofit their property rather than continue paying fees. Both annual and one-time fees can be adjusted for inflation however annual payments provide municipalities with more opportunity to increase fees over the course of a project's life span and therefore the option may have less risk of underfunding projects than a one-time payment. On the other hand, a one-time payment provides developers with certainty of their off-site mitigation costs and the option may have less administrative burden for municipalities compared to annual payments.

3.3 Summary of tradeoffs and potential beneficiaries of fee-in-lieu programs

For municipalities, the overarching tradeoffs of fee-in-lieu programs are:

- Flexibility from performance-based requirements *versus* increased risks and responsibilities.
- Efficiency and effectiveness gains *versus* equity concerns.
- Cost of on-site compliance *versus* cost of off-site mitigation and transaction costs.

Specific environmental and socio-economic benefit and risk tradeoffs are difficult to assess due to a conflation of factors, and knowledge gaps (e.g., interaction of different watershed processes, equivalence at different locations, appropriate time frame and scale of assessment, treatment costs) increase uncertainty of benefits and risks. Social factors such as community support for off-site projects also affect associated risks, and project size, property ownership, and environmental sensitivity at various locations could potentially increase or decrease environmental benefits and compliance costs. Table 3 summarizes the potential advantages and disadvantages of a fee-in-lieu approach.

Table 3: Summary of benefit and risk tradeoffs of fee-in-lieu programs.

Potential Advantages	Potential Disadvantages
A way to comply with stormwater regulations	Risk of inadequate mitigation
Increased flexibility for developers and municipality	Suitable mitigation sites must be identified
Investment directed to greatest need in watershed	Uncertainty of watershed-scale impacts
Meets multiple land use planning objectives	Trading values difficult to quantify
Increased efficiency and effectiveness of SCMs	Long term ownership and responsibility issues
Incentivize retrofits in built out areas	Legal and financial liability to municipality
Lower compliance cost	Higher compliance cost
Facilitate strategic planning	Financial risk to the public

All off-site mitigation projects may provide some degree of benefit but they also present a risk to the public due to the on-site impact left unmitigated. If an off-site project fails then the public ultimately has to pay for fixing the problem that would otherwise be the developers/on-site owner's mitigation responsibility. For example, unmitigated sites may contribute to pollutant runoff that someday may need to be addressed as part of urban retrofit programs, meaning the public takes on the cost of such retrofits (Inglis 2012).

A common perception of AC programs is that they favor the economic interests of developers over environmental protection however fee-in-lieu programs can serve diverse community interests with multiple environmental and economic benefits. Table 4 lists some of the reasons to participate in fee-in-lieu programs and identifies the division of benefits among stakeholders, from a municipality, developer and land owner perspective.

Table 4: Reasons to participate in fee-in-lieu programs, from a municipality, developer and land owner perspective. In this table 'municipality' represents both municipal and public benefit, and 'land owner' represents the benefit to private property owners of off-site locations.

	Beneficiaries		
Reasons for fee-in-lieu programs	Municipality	Developer	Land owner
On-site treatment constraints		✓	
On-site treatment costs		✓	
Operation and maintenance costs		✓	
Reliable operation and maintenance of SCMs	✓		
Watershed restoration and preservation objectives	✓		✓
Pollutant reduction goals	✓		
Municipal infrastructure management	✓		
Retrofitting objectives	✓		✓
Development and economic growth objectives	✓	✓	
Tax benefits			✓

Table 4 illustrates municipalities have much to gain from fee-in-lieu programs and these potential benefits may offset additional financial and liability risks. Private property owners participating in a fee-in-lieu program may benefit from environmental improvements to their properties, tax breaks and fee incentives however they also must bear 'opportunity costs' (e.g. missed financial gains due to development and land use restrictions placed on their property from a conservation easement or structural SCMs).

Drivers for alternative compliance in the Central Coast Region are discussed next within the context of the Region's PCRs.

4.0 Framework for developing alternative compliance programs in the Central Coast Region

4.1 Drivers of alternative compliance in the Central Coast Region

Alternative compliance programs are typically established in response to new regulations and the need to find cost effective solutions to achieve compliance. For example, water quality trading programs are commonly driven by Total Maximum Daily Loads and trades take advantage of cost differentials across a trading area (e.g., a watershed) to achieve pollutant reduction requirements at less cost. Numeric performance requirements for runoff retention are likely to be the main driver for alternative compliance programs in the Central Coast Region. In some locations the achievement of performance requirements will be technically infeasible (refer to Appendix A) and developers will seek off-site options. Another potential driver is a municipality's desire for a watershed planning approach to stormwater management. Municipalities may use a watershed plan, regional plan or urban sustainability area to justify AC for a regulated project without demonstrating technical infeasibility.

Depending on the nature of the final Central Coast Region PCRs, regulated development projects in the region will likely be required to retain anywhere from the 85^{th} to the 95^{th} percentile 24-hour rainfall event. Depending on local rainfall data, the difference between the old and new design stormwater requirements in some municipalities in the region may represent a substantial increase in runoff volume to be retained on-site. Approximately half the soils within the urban areas of the Central Coast Region have slow to very slow infiltrative soils C and D (CCTS 2012). Retention requirement may be technically infeasible for regulated projects located in a WMZ with a combination of 95^{th} percentile design requirements and slow infiltrative soils and these projects will likely require off-site compliance options.

The need for AC may be lessened due to mechanisms offered by the CCRWQCB to address technical infeasibility issues. For example, as currently drafted by CCRWQCB staff (September 6, 2012), regulated projects located in WMZ 1 are required to retain runoff from the 95^{th} percentile event via infiltration and projects in WMZ 2 are required to retain runoff from the 95^{th} percentile via storage, rainwater harvesting, infiltration, and/or evapotranspiration. The broad range of treatment choices (some of which are not dependent on soil type) may result in less demand for AC in WMZ 2 compared with WMZ 1. Projects in WMZ 2 are less likely to pursue AC due to technical infeasibility however the high cost of some treatments (e.g., green roofs, rain barrels) may provide incentive for developers to seek AC under a watershed or regional plan.

Regulated projects in WMZs with the 85^{th} percentile design event are less likely to require AC due to technical infeasibility or cost issues. However municipalities may desire a more holistic watershed planning approach to stormwater management rather than a piecemeal, parcel-scale approach and in-lieu fees could be a funding stream for priority projects in a watershed plan. For example, 'built out' jurisdictions are common in coastal towns in the Central Coast Region.

In lieu fees collected from redevelopment projects could be used to fund retrofits of older development that may otherwise not occur but represent the 'best bang for the buck' in terms of water quality improvement and community needs.

In-lieu fees would allow a municipality to fund 1:1 or aggregate mitigation off-site projects justified under technical infeasibility and/or a watershed planning approach. Additionally, establishing a fee-in-lieu rate allows developers to estimate their off-site retention costs in advance and make informed choices regarding whether to seek AC options or full on-site compliance requirements. The next section proposes a methodological framework to assist municipalities establish fee-in-lieu programs.

4.2 Methodological framework for fee-in-lieu programs

The methodological framework for fee-in-lieu programs consists of a series of program framing questions and a methodology to illustrate the process of establishing a program. A case study (refer to Appendix C) demonstrates the application of the methodology.

Framing questions for a fee-in-lieu program

The following series of questions aim to assist municipalities build their own program framework tailored to their watershed, community needs, administrative capacity, and benefit-risk tradeoffs:

- *Demand for alternative compliance*
  - Are developers or on-site property owners predicted to have a high, medium or low demand for off-site compliance?
  - Is demand expected to be consistent or sporadic?

- *Project scale*
  - Is off-site retention volume predicted to be large, medium or small?
  - Will off-site projects be 1:1 or aggregate mitigation (mitigation of off-site retention volume from more than one regulated project)?

- *Program scale*
  - Will alternative compliance be implemented under a site-specific technical infeasibility condition, or under a watershed planning approach such as a Watershed Plan, Regional Plan, and/or Urban Sustainability Area?

- *Land availability and constraints*
  - Will off-site projects to be located on public and/or private property?
  - Will the municipality or private property owners be responsible for long term operation and maintenance?
  - What are the constraints to land availability (e.g., low soil infiltration, steep slopes, sensitive habitat, willing land owners, community support)?

- *Jurisdiction*
  - Will off-site projects be located solely within a municipality's jurisdictional boundary or will projects outside the jurisdiction also be considered?
  - Will the municipality form partnerships or agreements with other municipalities, counties, or agencies?

- *Mitigation type*
  - What types of SCMs will be allowed at off-site projects?
  - What are the operation, maintenance, and monitoring requirements of the SCMs?
  - Will the trading currency be runoff reduction volume or another unit of measure?
  - Will 'out of kind' SCMs be considered?
  - How will MEP at the off-site location be established?
  - What quantitative analysis will be used to evaluate off-site compliance?

- *Prioritization criteria*
  - What criteria will be used to prioritize off-site locations, to maximize benefits and minimize risks?
  - How will the criteria be weighted?

- *Fee calculation*
  - Will in-lieu fees be estimated using a flat rate or will fee payment be determined on a project-by-project basis?
  - Will a fee rate be based on a pre-established portfolio of off-site mitigation projects or a 'typical' SCM installation?
  - What SCM life-cycle costs and life span will be used to estimate fees?

- *Fee schedule*
  - Will the fee schedule be a one-time payment (representing the cost of construction and operation and maintenance in perpetuity) or an annual fee paid by the on-site property owner (amortized over the project's lifespan)?

Methodology

A common fee-in-lieu scenario is the flat rate fee approach, with the fee based on a 'typical' SCM installation or a pre-established portfolio of off-site projects. Two major tasks for municipalities establishing either type of program are the estimation of the fee rate and identification of potential off-site locations. A flow diagram (Fig. 2) outlines a methodology to accomplish the tasks which begin with predictions of typical off-site retention volume requirements (runoff retention volume is the trading currency), identification of allowable SCMs, and estimation of SCM space requirements. Application of the methodology is demonstrated in a case study of a municipality in the Central Coast Region (refer to Appendix C).

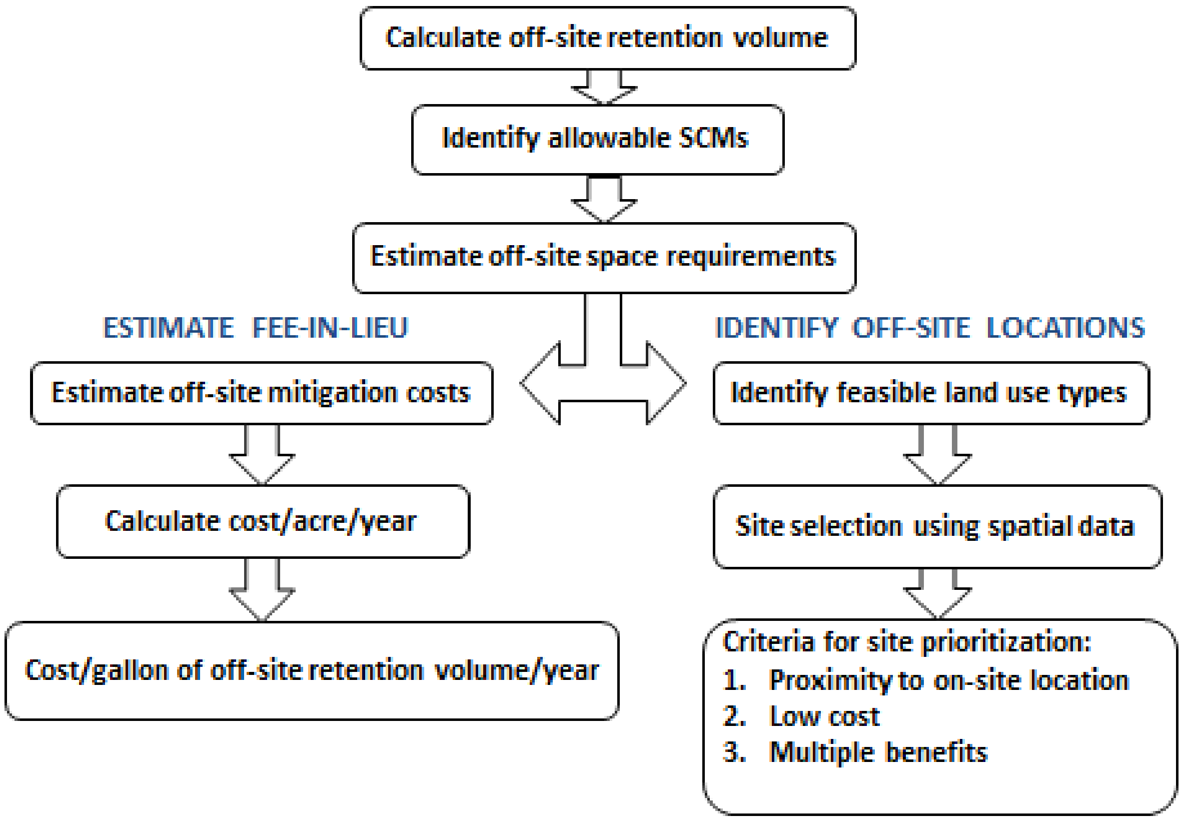

Figure 2: Methodology for fee-in-lieu estimation and off-site location identification. Ideally, off-site locations would be identified prior to the need for AC. Potential projects at the off-site locations would then be used to estimate mitigation costs and calculate in-lieu fees.

Municipalities may choose to identify an inventory of potential off-site project and base their fee rate on average cost of these projects or may choose to base their fee rate on the cost of a typical SCM and implementation scenario. Framing questions on land availability and constraints, jurisdiction, project and program scale, and associated spatial data will assist municipalities identify potential off-site projects or a typical SCM implementation scenario. The objective of the site prioritization criteria is to maximize benefits and minimize risks of off-site projects and weighting criteria will assist municipalities select projects tailored to their watershed and community needs. When a regulated project requires off-site compliance, the in-lieu fee is calculated by multiplying the flat fee rate (cost/gallon/time) by the off-site retention volume.

The fee amount required to mitigate an off-site retention volume should ideally reflect the life cycle costs of a typical off-site project or the average life cycle costs of an inventory of potential projects. Cost categories for fee-in-lieu programs will depend on program characteristics and may include:

- *Design and engineering costs*
  (e.g., grading plans, installation plan)
- *Construction costs*
  (e.g., materials, equipment usage, labor)
- *Operation and maintenance costs*
  (e.g., periodic (at least 20 years) maintenance tasks such as pruning, weeding, sediment removal, may include replacement costs).
- *Land costs*
  (e.g., easement purchases, opportunity costs (the foregone opportunity to use the land for another purpose)).
- *Overhead costs*
  (e.g., program administration, site identification, project management, site inspections, building and administrative overhead, equipment acquisition and maintenance, interest on loans, accounting fees, insurances, and taxes) (WVDEP 2012).

4.3 Summary of fee-in-lieu case study in the City of Watsonville

A case study (refer to Appendix C) was conducted with the City of Watsonville in Santa Cruz County to illustrate concepts discussed in the report and to demonstrate how a municipality in the Central Coast Region might implement an AC program. Watsonville has two Watershed Management Zones, WMZs 1 and 4, and proposed post-construction retention requirements are to retain the 95th percentile rainfall event via infiltration. It was hypothesized the increase in design retention volume and heavy clay (low infiltration) soils within the jurisdiction may cause a demand for off-site compliance among new development and redevelopment projects. Municipal objectives for the planning level exercise were to gain insight into off-site compliance need, fee-in-lieu options, and feasibility of off-site projects on City owned land.

Using the methodology from Section 4.2 as a guide, the four main steps of the study were as follows: (1) estimation of off-site retention volume requirements for two development scenarios, (2) estimation of acreage requirements for a selection of off-site SCMs, (3) estimation of in-lieu fee rates ($/gallon/year) using planning level SCM costs and acreage requirements, and (4) GIS analysis to identify potential off-site locations on City-owned land. The case study was for illustrative purposes only and some of the details within the analysis were simplified. Results from the study may be applicable to other municipalities in the Region, particularly those with the 95th percentile design storm event requirement, low infiltration soils, or municipalities considering a flat rate in-lieu fee approach for their AC program. Results of the study are summarized below:

- The estimation of off-site retention volume requirements for two development scenarios indicate some regulated projects in the City of Watsonville may need off-site compliance options to meet post-construction retention requirements. Only small amounts of runoff mitigation may be necessary therefore small scale mitigation projects, either 1:1 or aggregate projects, are likely to be more suitable for the City's fee-in-lieu program than large regional projects.

- The development scenarios were expected to require off-site mitigation of retention volume due to their locations in low infiltration soils however the proposed ten percent adjustment rule for technical infeasibility (refer to Appendices A and B) significantly reduced retention requirements and mitigation costs. Likewise, if the regulated projects were located in an area designated as a USA then virtually no off-site mitigation would have been necessary.

- Soil type at off-site locations has a strong influence on the space requirements and costs of infiltration/bioretention SCMs. Estimates of in-lieu fee rates (cost/gallon/year) were up to 15 times more costly on low infiltration soils compared to high infiltration soils.

- The broad range of in-lieu fee rate estimates ($0.01-$5.77/gallon/year) across different SCM options (e.g., infiltration, bioretention, rainwater harvesting, evapotranspiration) highlights the challenge of accurately estimating a flat rate fee and the risk of underfunding off-site compliance projects.

- The study identified potential off-site locations on City-owned land that meet size requirements, site constraints, and basic prioritization criteria such as proximity to on-site development, low cost, and potential for multiple benefits. However in the long term, the major presence of low infiltration soils within the City jurisdiction will likely limit cost effective off-site options within Watsonville.

- A watershed plan which targets priority mitigation areas outside the City jurisdiction, such as groundwater recharge areas and riparian buffers, may deliver the most environmental benefits and cost effective mitigation for the municipality.

4.4 Recommendations for AC programs in the Central Coast Region

It is recommended that municipalities in the Central Coast Region use fee-in-lieu payment as the main funding mechanism for their AC programs with runoff reduction as their trading currency. Ideally, AC programs maximize environmental and economic benefits and minimize compliance and financial risks. Design challenges include optimizing flexibility and reducing uncertainty and transaction costs. To overcome these challenges it is recommended that municipalities identify off-site locations prior to demand, develop prioritization and weighting criteria for off-site projects, and build safeguards into programs to reduce environmental and socioeconomic risks. Further research at the regional level is recommended to assist municipalities develop their fee-in-lieu programs.

The primary recommendation is for municipalities to plan ahead to identify potential off-site locations prior to AC demand. Municipalities can get ahead of AC demand and maximize benefits by identification of prioritized locations that have been through a basic feasibility assessment for AC and can be used to meet compliance as well as watershed and community objectives. Planning allows municipalities to use AC to achieve broader community goals such as the integration of comprehensive community greening objectives. For example, many communities would like to see street landscaping to enhance existing highly urban areas of their community but have no money for implementation. By planning AC sites, AC dollars can be used to fulfill multiple objectives including stormwater mitigation, greener communities, improved streets, enhanced economic vitality, and green infrastructure networks (Inglis 2013). Planning ahead is also vital for watershed plans and in-lieu fee estimation, and to avoid the scramble to implement off-site projects within the allocated time period.

It is recommended that municipalities develop prioritization and weighting criteria for off-site projects to streamline AC program administration, minimize transaction costs and uncertainty, and maximize cost-benefits. The hierarchy of mitigation projects will depend on many factors (e.g., AC demand, availability of sites, and watershed priorities) and municipalities should tailor prioritization criteria to environmental and community needs however a general mitigation hierarchy is suggested below:

1) In-kind projects in Right-of-Ways (ROWs) within the jurisdiction;
2) In-kind projects on other public land within the jurisdiction;
3) In-kind projects on private property within the jurisdiction;
4) In-kind projects on public land outside the jurisdiction;
5) Out-of-kind projects on public land, inside or outside the jurisdiction.

Municipalities would be wise to conduct planning to identify potential off-site locations on publically owned land that meet basic technical and other site criteria requirements. AC program transaction costs may be reduced using public lands and ROWs are preferred due to the potential for reducing off-site project maintenance costs (e.g., municipalities already maintain ROWs and there is potential to involve neighboring private owners in maintenance tasks). Also public ROWs may be the ideal size for anticipated AC demands (i.e., small off-site mitigation requirement are predicted). It is recommended that municipalities with higher AC demand aggregate 2 or 3 fee collections to implement larger and potentially more cost effective projects and to reduce the maintenance burden of many small off-site projects. Where larger off-site locations are not feasible (e.g., due to soil or cost constraints) municipalities may consider locating off-site project outside their jurisdiction. Out-of-kind projects typically have a higher risk of inadequate mitigation and it is recommended that municipalities use out-of-kind projects only when watershed priorities and cost-benefit tradeoffs have been considered.

It is recommended municipalities build safety factors into their AC programs to further reduce environmental and socioeconomic risks. These may include:

- more stringent requirements for on-site locations in sensitive areas (e.g., higher trading ratios) to avoid 'hot spot' development;
- off-site projects using SCMs consistent with their location's WMZs;
- development of trading ratios to create net environmental benefits;
- only allow mitigation types with known costs;
- use an annual fee schedule rather than one-time fee payments;
- design USA restrictions to encourage smart growth (e.g., infill and high density development) in downtown areas but avoid allowing all smart growth projects to be designated USA or restricting USAs to only downtown areas.

It is recommended that further research be conducted at the regional level to assist municipalities with their AC programs. Information and research gaps identified include:

- examples of legal agreements, MOUs, etc. between AC parties (e.g., municipality and developer, municipality and other municipalities);
- better cost information broken out into planning, design, construction, and operation and maintenance to improve in-lieu fee estimation;
- better cost data for different AC scenarios (e.g., for new development, redevelopment, different soils);
- better understanding of methodologies to determine cost-benefits of out-of-kind mitigation;
- metrics suitable for local climate to translate mitigation units into common trading currency (e.g., In the Central Coast Region, X amount of stormwater volume equals Y amount of riparian restoration).
- better understanding of methodologies to develop trading ratios;
- better understanding of how to assess cumulative risks of unmitigated runoff at parcel scale and watershed scale.

5.0 Conclusion

This report synthesized the legal, environmental, technical and socioeconomic considerations of alternative compliance and provided a framework to assist municipalities in the Central Coast Region develop AC programs which meet CCRWQCB's proposed PCRs for Municipal Phase I and II Stormwater NPDES permits. Additionally, the planning level exercise conducted with the City of Watsonville evaluated feasibility aspects of alternative compliance and demonstrated how a municipality might implement an AC program.

It is recommended that municipalities in the Central Coast Region use fee-in-lieu payment as the main funding mechanism for their AC programs with runoff reduction as their trading currency. The case study piloted methodology for fee-in-lieu estimation and off-site location identification and results indicate some development projects in the City of Watsonville may need off-site compliance options to meet proposed PCRs however only small amounts of runoff mitigation may be necessary. Utilizing City owned property for off-site mitigation seemed feasible and locations were prioritized according to criteria such as space requirements, proximity to on-site development, low cost, and potential for multiple benefits. The major presence of soil type D within the City jurisdiction may limit cost effective off-site options within Watsonville and a watershed approach which also targets priority mitigation areas outside the City jurisdiction, such as groundwater recharge areas and riparian buffers, may deliver the most environmental benefits and cost effective mitigation for the municipality. Fee-in-lieu rates were estimated using planning level SCM life cycle costs such as construction, pre-construction, and annual operation and maintenance costs. Fee-in-lieu options included annual payments, one-time payment in perpetuity, and computing cost per gallon rates by averaging all SCM costs or a selection of SCMs tailored to municipal conditions (e.g. soil constraints, SCM mitigation type). The broad range of costs across different fee-in-lieu options highlighted the difficulty of choosing a single fee-in-lieu rate and the risk of underfunding off-site compliance projects.

A common perception of AC programs is that they favor the economic interests of developers over environmental protection however this report found fee-in-lieu programs can serve diverse community interests with multiple environmental and economic benefits. All off-site mitigation projects may provide some degree of benefit but they also present a risk to the public due to the on-site impact left unmitigated. If an off-site project fails then the public ultimately has to pay for fixing the problem that would otherwise be the developers/on-site owner's mitigation responsibility. For municipalities, the overarching tradeoffs of fee-in-lieu programs are: (1) flexibility from performance-based requirements *versus* increased risks and responsibilities; (2) efficiency and effectiveness gains *versus* equity concerns; and (3) cost of on-site compliance *versus* cost of off-site mitigation and transaction costs. Specific environmental and socio-economic benefit and risk tradeoffs are difficult to assess due to a conflation of factors and knowledge gaps (e.g., interaction of different watershed processes, equivalence at different locations, appropriate time frame and scale of assessment, treatment costs) increase uncertainty of benefits and risks. Social factors such as community support for off-site projects also affect associated risks, and project size, property ownership, and environmental sensitivity at various locations could potentially increase or decrease environmental benefits and compliance costs.

In conclusion, design challenges for AC programs include optimizing flexibility and reducing uncertainty and transaction costs. To overcome these challenges it is recommended that municipalities identify off-site locations prior to demand, develop prioritization and weighting criteria for off-site projects, and build safeguards into programs to reduce environmental and socioeconomic risks. Future studies should explore information gaps including project cost information, translation of mitigation units into common trading currency, and methodologies to determine cost-benefits and cumulative risks of out-of kind mitigation, to assist municipalities develop AC programs which maximize environmental and economic benefits and minimize compliance and financial risks.

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Appendix A

ALTERNATIVE COMPLIANCE LANGUAGE FROM THE POST-CONSTRUCTION STORMWATER REQUIREMENTS FOR DEVELOPMENT PROJECTS IN THE CENTRAL COAST REGION

The following Alternative Compliance language is from CCRWQCB's currently proposed requirements as of writing of this report: *Resolution No. R3-2012-0025 Post-Construction Stormwater Management Requirements for Development Projects in the Central Coast Region, California Regional Water Quality Control Board, Central Coast Region, September 6, 2012 (pp. 13-15)*. The entire document is available from: http://www.waterboards.ca.gov/rwqcb3/water_issues/programs/stormwater/docs/lid/hydromod_lid_docs/PCRs_final.pdf

C. Alternative Compliance (Off-Site Compliance)

Alternative Compliance refers to Water Quality Treatment, Runoff Retention and Peak Management Performance Requirements that are achieved off-site through mechanisms such as developer fee-in-lieu arrangements and/or use of regional facilities. Alternative Compliance may be allowed under the following circumstances:

1) Technical Infeasibility

Off-site compliance with Water Quality Treatment, Runoff Retention, or Peak Management Performance Requirements may be allowed when technical infeasibility limits or prevents use of structural Stormwater Control Measures.

a) To pursue Alternative Compliance based on technical infeasibility, the Regulated Project applicant, for Regulated Projects outside of Urban Sustainability Areas, must submit a site-specific hydrologic and/or design analysis conducted and endorsed by a registered professional engineer, geologist, architect, and/or landscape architect, demonstrating that compliance with the applicable numeric Post-Construction Stormwater Management Requirements is technically infeasible.

b) The Regulated Project applicant must submit a description of the project(s) that will provide off-site mitigation. The proposed off-site projects may be existing facilities and/or prospective projects that are as effective in maintaining watershed processes as implementation of the applicable Post-Construction Stormwater Requirements on-site. The description shall include:

> i) The location of the proposed off-site project(s), which must be within the same watershed as the Regulated Project. Alternative Compliance project sites located outside the watershed may be approved by the Central Coast Water Board Executive Officer.
>
> ii) A schedule for completion of offsite mitigation project(s), where the off-site mitigation project(s) has not been constructed.

c) Technical infeasibility may be caused by site conditions, including:

> i) Depth to seasonal high groundwater limits infiltration and/or prevents construction of subgrade stormwater control measures.
>
> ii) Depth to an impervious layer such as bedrock limits infiltration.

iii) Sites where soil types significantly limit infiltration.

iv) Sites where pollutant mobilization in the soil or groundwater is a documented concern.

v) Space constraints (e.g., infill projects, some redevelopment projects, high density development).

vi) Geotechnical hazards.

vii) Stormwater Control Measures located within 100 feet of a groundwater well used for drinking water.

viii) Incompatibility with surrounding drainage system (e.g., project drains to an existing stormwater collection system whose elevation or location precludes connection to a properly functioning treatment or flow control facility).

2) Approved Watershed or Regional Plan

An approved Watershed or Regional Plan as described below (Section C.2.a.), may be used to justify Alternative Compliance for a Regulated Project's numeric Runoff Retention and Peak Management Performance Requirements without demonstrating technical infeasibility.

a) The Permittee must submit the proposed Watershed or Regional Plan to the Central Coast Water Board Executive Officer for approval. Watershed and Regional Plans must take into consideration the long-term cumulative impacts of urbanization including existing and future development and include, at minimum:

i) A description of the project(s) that will provide off-site mitigation. The proposed offsite projects may be existing facilities and/or prospective projects.

ii) The location of the proposed off-site project(s), which must be within the same watershed as the Regulated Project. Alternative Compliance project sites located outside the watershed may be approved by the Central Coast Water Board Executive Officer.

iii) Demonstration that implementation of projects per the Watershed or Regional Plan will be as effective in maintaining watershed processes as implementation of the applicable Post-Construction Stormwater Requirements on-site. The proposal must include quantitative analysis (e.g., calculations and modeling) used to evaluate offsite compliance.

iv) A schedule for completion of offsite mitigation project(s), where the off-site mitigation project(s) has not been constructed.

b) The Permittee may use projects identified per the Watershed or Regional Plan to meet Water Quality Treatment Performance Requirements off-site only when:

i) The Regulated Project applicant has demonstrated that on-site water quality treatment is infeasible as described in Sections C.1.a and C.1.c., and

ii) The proposed off-site project(s) has been demonstrated to comply with the Water Quality Treatment Performance Requirements for the Regulated Project.

3) Approved Urban Sustainability Area

The Permittee may allow Regulated Projects located within an approved Urban Sustainability Area to pursue Alternative Compliance for numeric Runoff Retention and Peak Management Performance Requirements without demonstrating technical infeasibility.

a) The Urban Sustainability Area may only encompass redevelopment in high density urban centers (but not limited to incorporated jurisdictional areas) that are pedestrian oriented and/or transit-oriented development projects intended to promote infill of existing urban areas. The Permittee must submit a proposal to the Central Coast Water Board Executive Officer for approval of an Urban Sustainability Area. The USA proposal must include, at minimum:

i) A definition and delineation of the USA for high-density infill and redevelopment for which area-wide approval for Alternative Compliance is sought.

ii) Information and analysis that supports the Permittee's intention to balance water quality protection with the needs for adequate housing, population growth, public transportation, land recycling, and urban revitalization.

iii) Demonstration that implementation of Alternative Compliance for Regulated Projects in the USA will meet or exceed the on-site requirements for Runoff Retention and Peak Management. The proposal must include quantitative analysis (e.g., calculations and modeling) used to evaluate off-site compliance. Identification of specific off-site projects is not necessary for approval of the USA designation.

b) The Permittee may allow Regulated Projects in a USA to meet Water Quality Treatment Performance Requirements off-site only when:

i) The Regulated Project applicant has demonstrated that on-site water quality treatment is infeasible as described in Sections C.1.a. and C.1.c., and

ii) The proposed off-site project(s) have been demonstrated to comply with the Water Quality Treatment Performance Requirements.

c) The Central Coast Water Board Executive Officer will deem complete a Permittee's USA proposal within 60 days of receiving a complete proposal. The Central Coast Water Board Executive Officer will approve or deny the proposal within 120 days of a proposal being deemed complete.

4) <u>Other situations as approved by the Central Coast Water Board Executive Officer.</u>

5) <u>Location of Alternative Compliance Project(s)</u> – The location of the proposed off-site project(s) must be within the same watershed as the Regulated Project. Alternative Compliance project sites located outside the watershed may be approved by the Central Coast Water Board Executive Officer.

6) <u>Timing and Funding Requirements for Alternative Compliance Projects</u> – The Permittee shall develop a schedule for the completion of off-site mitigation projects, including milestone dates to identify funding, design, and construction of the off-site projects.

a) Complete the project(s) as soon as practicable and no longer than four years from the date of the certificate of occupancy for the project for which off-site mitigation is required, unless a longer period is otherwise authorized by the Central Coast Water Board Executive Officer.

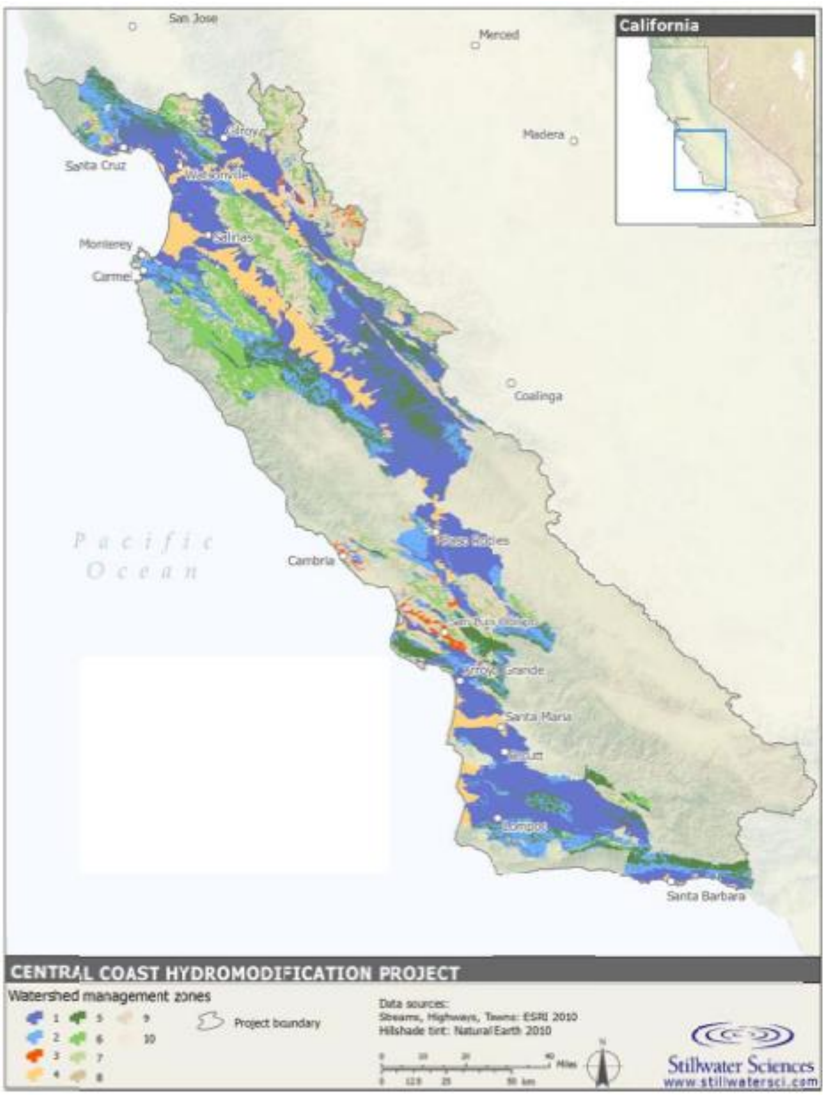
b) The timeline for completion of the off-site mitigation project may be extended, up to five years with prior Central Coast Water Board Executive Officer approval. Central Coast Water Board Executive Officer approval will be granted contingent upon a demonstration of good faith efforts to implement an Alternative Compliance project, such as having funds encumbered and applying for the appropriate regulatory permits.

c) Require sufficient funding be transferred to the Permittee for public off-site mitigation projects. Require private off-site mitigation projects to transfer sufficient funding to a Permittee controlled escrow account, or provide the Permittee with appropriate project bonding within one year of the initiation of construction of the Regulated Project.
d) The Permittee may establish different timelines and requirements that are more restrictive than those outlined above.

Appendix B

MAP OF WATERSHED MANAGEMENT ZONES IN THE CENTRAL COAST REGION AND POST-CONSTRUCTION PERFORMANCE REQUIREMENTS FOR RUNOFF RETENTION

The following map and performance requirements are from CCRWQCB's currently proposed requirements as of writing of this report: *Resolution No. R3-2012-0025 Post-Construction Stormwater Management Requirements for Development Projects in the Central Coast Region, California Regional Water Quality Control Board, Central Coast Region, September 6, 2012 (pp. 6, 8, and Attachment A).* The entire document is available from: http://www.waterboards.ca.gov/rwqcb3/water_issues/programs/stormwater/docs/lid/hydromod_lid_docs/PCRs_final.pdf



Map of Watershed Management Zones in the Central Coast Region. Source: Booth, et al. 2012.

4) Performance Requirement No. 3: Runoff Retention

a) The Permittee shall require Regulated Projects, except detached single-family homes, that create and/or replace >15,000 square feet of impervious surface (collectively over the entire project site), and detached single-family homes > 15,000 square feet of Net Impervious Area, in WMZs 1, 2, 5, 6, 8 and 9, and those portions of WMZs 4, 7, and 10 that overlie designated Groundwater Basins (Attachment B) to meet the Runoff Retention Performance Requirements in Sections B.4.b. and B.4.c. using the LID Development Standards in Section B.4.d. for optimal management of watershed processes.

b) Adjustments to the Runoff Retention Performance Requirements for Redevelopment -Where the Regulated Project includes replaced impervious surface, the below adjustments apply. These adjustments are accounted for in the Tributary Area calculation in Attachment D.

i) Redevelopment Projects outside an approved Urban Sustainability Area, as described in Section C.3. – The total amount of replaced impervious surface shall be multiplied by 0.5 when calculating the volume of runoff subject to Runoff Retention Performance Requirements.

ii) Redevelopment Projects located within an approved Urban Sustainability Area (Section C.3.) – The total amount of runoff volume to be retained from replaced impervious surfaces shall be equivalent to the pre-project runoff volume retained.

c) The Permittee shall require Regulated Projects, subject to the Runoff Retention Performance Requirements, to meet the following Performance Requirements:

<u>i) Watershed Management Zone 1 and portions of Watershed Management Zones 4, 7 and 10 which overlie designated Groundwater Basins:</u>

(1) Retain 95th Percentile Rainfall Event – Prevent offsite discharge from events up to the 95th percentile 24-hour rainfall event as determined from local rainfall data.

(2) Compliance must be achieved via infiltration.

<u>ii) Watershed Management Zone 2:</u>

(1) Retain 95th Percentile Rainfall Event – Prevent offsite discharge from events up to the 95th percentile 24-hour rainfall event as determined from local rainfall data.

(2) Compliance must be achieved via storage, rainwater harvesting, infiltration, and/or evapotranspiration.

<u>iii) Watershed Management Zones 5 and 8:</u>

(1) Retain 85th Percentile Rainfall Event – Prevent offsite discharge from events up to the 85th percentile 24-hour rainfall event as determined from local rainfall data.

(2) Compliance must be achieved via infiltration.

<u>iv) Watershed Management Zones 6 and 9:</u>

(1) Retain 85th Percentile Rainfall Event – Prevent offsite discharge from events up to the 85th percentile 24-hour rainfall event as determined from local rainfall data.

(2) Compliance must be achieved via storage, rainwater harvesting, infiltration, and/or evapotranspiration.

e) Off-Site Mitigation – Off-site mitigation of full Retention Volume per Section B.4.d.vi. is not required where technical infeasibility as described in Section C.1.c. limits on-site compliance with the Runoff Retention Performance Requirement AND ten percent of a project's Equivalent

Impervious Surface Area has been dedicated to retention-based Stormwater Control Measures. The Water Quality Treatment Performance Requirement is not subject to this adjustment, i.e., mitigation to achieve full compliance with the Water Quality Treatment Performance Requirement is required on- or off-site.

Appendix C

CITY OF WATSONVILLE AC CASE STUDY

Introduction

The Central Coast Regional Water Quality Control Board (CCRWQB) will be requiring hydromodification control and LID for certain new development and redevelopment projects as part of their “Post-construction Stormwater Management Requirements for Development Projects in the Central Coast Region” (PCRs). Proposed PCRs include retention requirements to retain the 85th or 95th Percentile storm event, keyed to Watershed Management Zones (refer to Appendix B). For example, WMZ 1 requires retention of the 95th Percentile rainfall event via infiltration, while WMZ 6 requires retention of the 85th Percentile rainfall event through storage, rainwater harvesting, infiltration and/or evapotranspiration. The performance criteria may significantly increase design retention volume in some locations and technical infeasibility and/or costs may cause developers to seek off-site alternative compliance to meet their retention requirements.

The case study is a planning level exercise conducted with the City of Watsonville to evaluate feasibility aspects of alternative compliance. The general purpose of the study is to demonstrate how a municipality might implement an AC program, illustrate concepts discussed in the report, and to pilot methodology (refer to Section 4.2) for fee-in-lieu estimation and off-site location identification. Specific goals of the study are to evaluate runoff retention requirements for two development scenarios within the City of Watsonville (Cherry Blossom residential housing development and Grocery Outlet commercial redevelopment) and to develop AC options for the projects. The case study is for illustrative purposes only and some of the details within the analysis have been simplified. The work is based on CCRWQB’s proposed PCRs (drafted September 6, 2012) and some of the calculations are based on factors that may not be in the final approved PCRs (CCPCR 2012). Municipal objectives of this preliminary investigation are to gain insight into off-site compliance need, fee-in-lieu options, and feasibility of off-site projects on City owned land.

Study area

Description of Watsonville municipality

The City of Watsonville is located in the Pajaro River watershed at the southern end of Santa Cruz County, on the central coast of California. It has a Mediterranean climate and an average annual rainfall of 23 inches with substantial year-to-year variability (Keeling and Roques 2005). The City is approximately 6.5 square miles, mostly flat, and comprised of three subwatersheds which drain to the Pajaro River, Salsipuedes Creek, or Watsonville Sloughs (Fig.1). The Sloughs drain to the Pajaro River and thence to Monterey Bay and were once a more extensive wetland and estuarine complex that has been modified (e.g., channelized and filled to drain surface water) to meet the needs of agriculture and urban development (Hager et al. 2004). The Slough area is home to diverse plant ecosystems which provide nesting sites and habitat to rare, threatened or endangered migratory and wetland birds and other biotic resources (Hager et al. 2004).

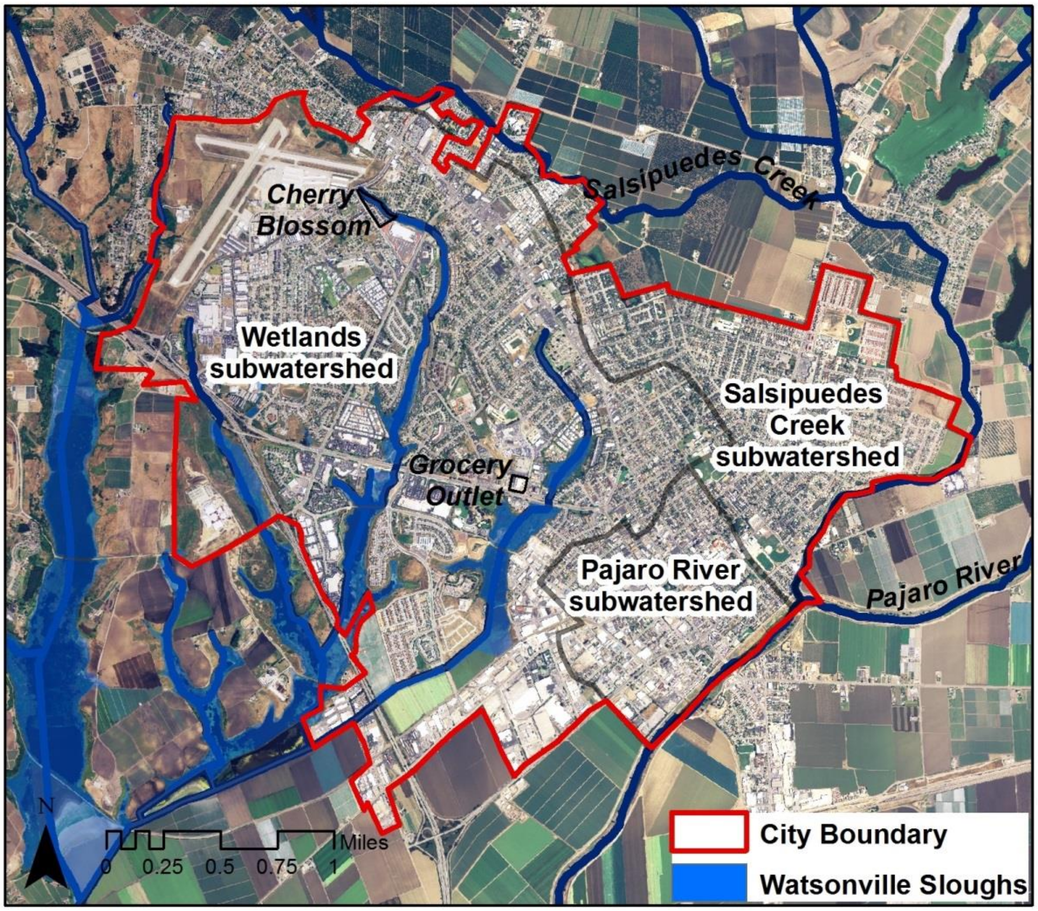


Figure 1: 2009 aerial image of Watsonville illustrating the City jurisdiction and three subwatersheds (Data source: CaSIL and City of Watsonville). Cherry Blossom and Grocery Outlet development scenarios are located in the Wetlands subwatershed.

Watsonville has a population of 51,500 and is the fastest growing city in Santa Cruz County, growing 16 percent from 2000 to 2010 (2010 Census). The City's economy is predominantly centered on industrial agriculture. Land use within the City includes urban residential, commercial and industrial development while agricultural land use is outside the City Boundary. Water quality issues in surrounding waterbodies include Total Maximum Daily Load (TMDL) for fecal coliform in the Corralitos/Salsipuedes Creek watershed, pathogen TMDL in Watsonville Sloughs, and TMDLs for nutrients, pesticides, fecal coliform, sediment and nitrate in the Pajaro River [CCRWQCB 2012]. Land cover within the City is highly impervious. Pajaro River (downtown area), Salsipuedes Creek, and Wetlands subwatersheds have 80%, 62% and 55% impervious cover respectively within the City limit (based on 2010 aerial imagery). Wetlands subwatershed has the most opportunity/pressure for new development projects.

The types of Stormwater Control Measures (SCMs) used to mitigate runoff are influenced by watershed management strategies. Watsonville has two Watershed Management Zones, WMZs 1 and 4 (Fig.2).

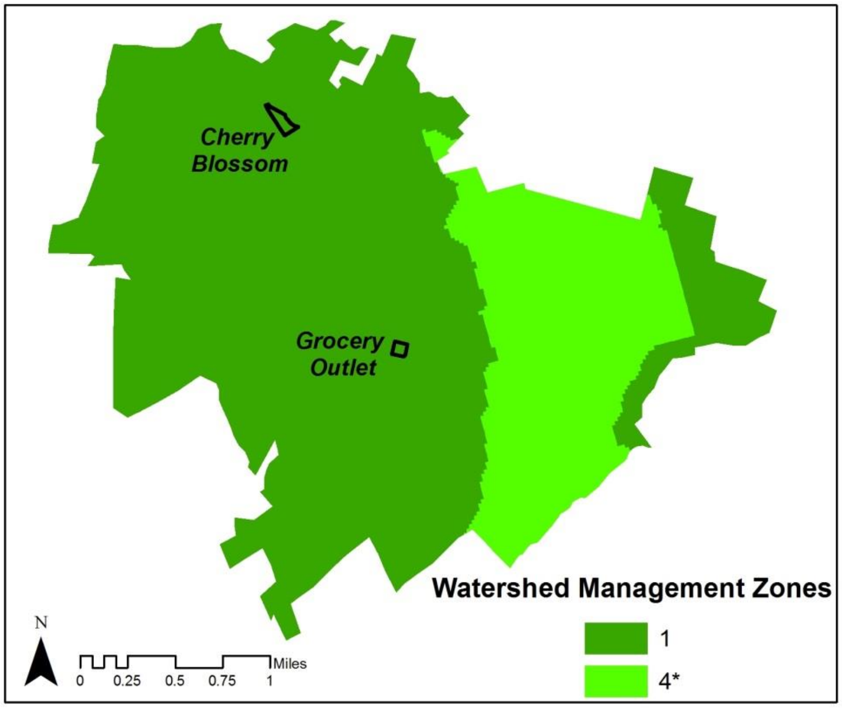


Figure 2: Watershed Management Zones within the City of Watsonville jurisdiction (Data source: Stillwater Sciences). Proposed PCRs for development projects in WMZs 1 and 4 are to retain the 95th Percentile rainfall event via infiltration.

The dominant watershed process in WMZ 1 is infiltration and management strategies should minimize overland flow and promote infiltration. The dominant watershed processes in WMZ 4 are those providing chemical and biological remediation of runoff, and management strategies should focus on infiltration because it overlies a groundwater basin (refer to Appendix B). Proposed PCRs for development projects in WMZs 1 and 4 are to retain the 95th Percentile rainfall event via infiltration. Infiltration SCMs include permeable pavement, vegetated swales, and bioretention cells.

Soil type can influence the effectiveness of infiltration/retention based SCMs and affect SCM sizing and costs. Watsonville has mostly clay soil with low infiltration rates and high runoff potential (soil type D) which commonly occurs in the Wetland subwatershed (Fig.3). Soils with moderate infiltration rates (soil type B) occur mainly in the Pajaro River and Salsipuedes Creek subwatersheds.

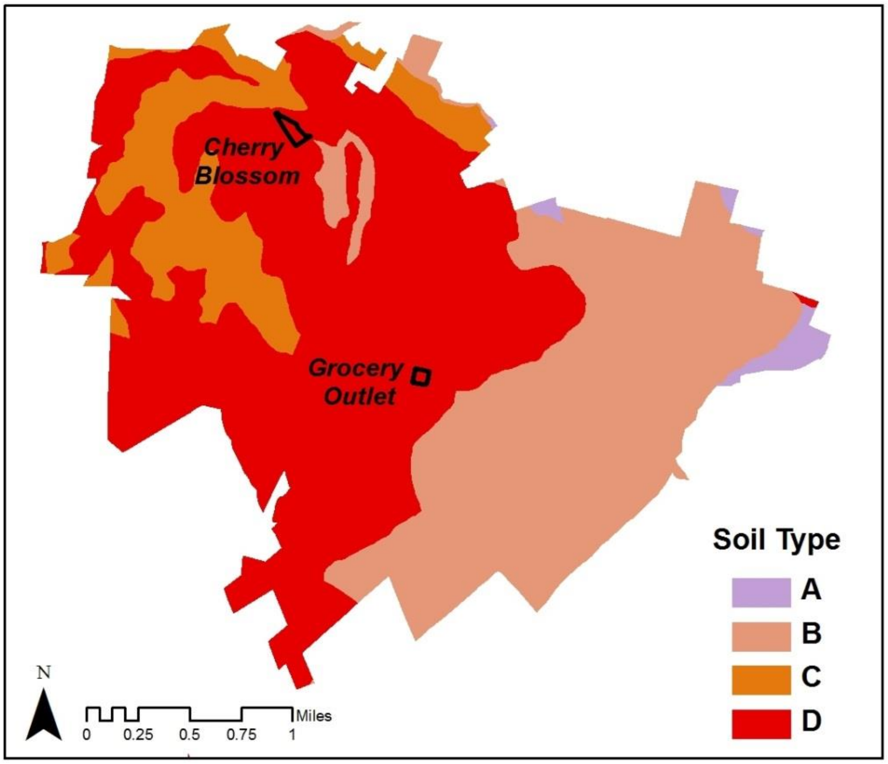


Figure 3: Soil types within City of Watsonville jurisdiction, classified by infiltration rates (Data source: SSURGO). Soil type A (well drained sands or gravels) has high infiltration rates while soil type D (heavy clay soil) has very slow infiltration rates and high runoff potential. Most of the Wetlands subwatershed, including Cherry Blossom and Grocery Outlet development scenarios, has soil type D.

Description of development scenarios

Cherry Blossom and Grocery Outlet are two projects recently developed within the Wetlands subwatershed on type D soil. Cherry Blossom is a new development of high density "smart growth" residential housing (Figures 4 and 5) and Grocery Outlet is a commercial development project (Figures 6 and 7).

Figure 4: Cherry Blossom new development project (photo: V.Pristel). The Cherry Blossom project is a high density ‘smart growth’ residential housing development located in the Wetlands subwatershed on soil type D.

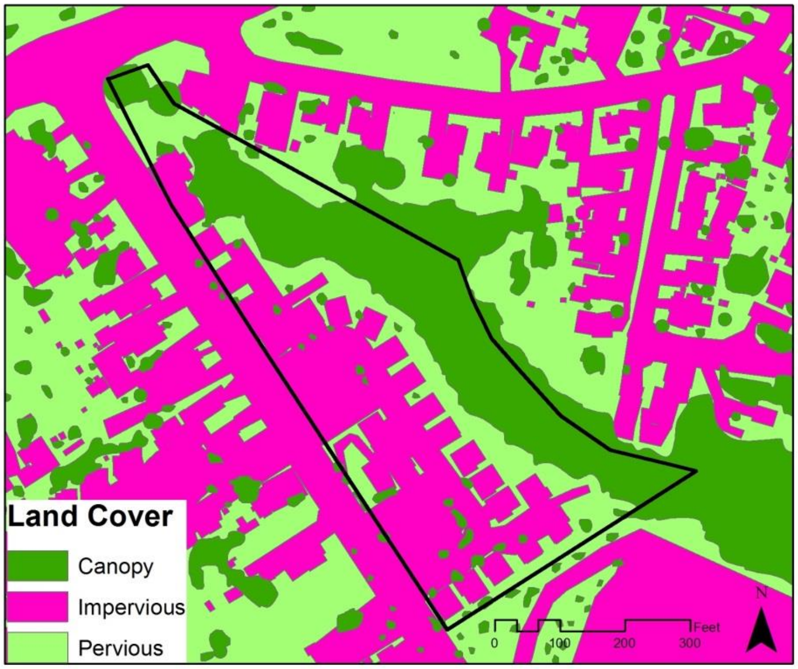


Figure 5: Land cover of the Cherry Blossom project illustrating tree canopy, impervious and pervious surfaces (Data source: City of Watsonville, derived from 2010 NAIP aerial imagery, 1m resolution).

Figure 6: Grocery Outlet commercial redevelopment (photo: V.Pristel). The project is located in the Wetlands subwatershed on soil type D.

Figure 7: Land cover of the Grocery Outlet project illustrating predominately impervious surfaces (Data source: City of Watsonville, derived from 2010 NAIP aerial imagery, 1m resolution).

Methods

The study piloted methodology (Fig.8) from report section 4.2 to estimate fee-in-lieu payments and identify potential off-site locations within the municipality.

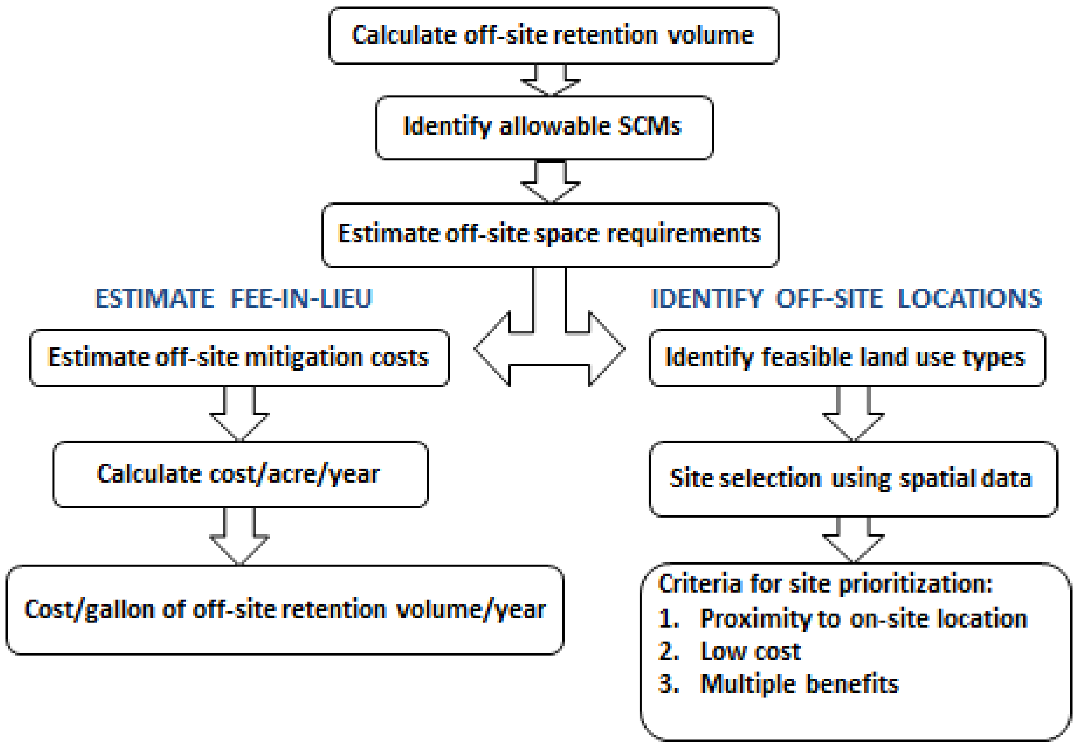


Figure 8: Methodology for fee-in-lieu estimation and off-site location identification.

Using the methodology (Fig. 8) as a guide, the four main steps of the study were as follows: (1) estimate off-site retention volume requirements of the two development scenarios, (2) estimate acreage requirements for a selection of off-site SCMs, (3) estimate fee-in-lieu ($/gallon/year) using SCM costs and acreage requirements, and (4) GIS analysis to identify potential off-site locations on City-owned land.

Step 1: Estimate off-site retention volume requirements of the two development scenarios

Off-site mitigation retention volume is influenced by many on-site factors including impervious cover, use of retention-based SCMs, development type (e.g., new versus redevelopment), and also by its location within the watershed (e.g., WMZ, technical constraints, USA). Cherry Blossom housing development and Grocery Outlet redevelopment were constructed before the proposed PCRs. To determine if off-site mitigation would be needed under a 95th Percentile performance requirement for WMZ 1 it was assumed that the development projects had been designed to retain the 85th Percentile rainfall event to the maximum extent practicable and the difference in design retention volumes (between the 85th and 95th percentile runoff events) represented the remaining runoff to be retained. Design retention volume was computed using methodology proposed by CCRWQB's draft PCRs (CCPCR 2012; CCTS 2012):

- The 85th and 95th percentile storm events for Watsonville were determined using 30 years (1982 – 2011) of daily precipitation data from Watsonville Waterworks weather station (UCD 2012).
- The runoff coefficient C for each site was determined using the equation:
  $$C = 0.858 * i^3 - 0.78 * i^2 + 0.774 * i + 0.04$$
  where i is the fraction of the site area that is impervious (estimated using impervious cover and site survey maps).
- Retention volume V was calculated using the equation:
  $$V = C * \text{Rainfall Depth}_{(85th, 95th)} * \text{site area} * 1.963$$
  where 1.963 is the 48-hour drawdown regression coefficient.

Proposed PCRs state off-site mitigation of full retention volume is not required where technical infeasibility limits on-site compliance (Appendix A). It was assumed soil constraints at Cherry Blossom and Grocery Outlet locations (soil type D) qualified projects for the ten percent adjustment to retention requirements (i.e., no off-site mitigation is required if 10% of the on-site project's Equivalent Impervious Surface Area is allocated to retention-based SCMs) (CCPCR 2012). An on-site retention feasibility factor (the ratio of design retention volume to area allocated to structural SCMs) was used to calculate potential off-site mitigation retention volume (CCPCR 2012). The potential off-site volume represents the actual off-site volume if it is less than the remaining design retention volume.

AC language contains an Urban Sustainability Area (USA) option which also reduces retention volume requirements (i.e., 50% of a project's impervious surface is not subject to the retention performance requirement if the on-site project is located within a USA) (CCPCR 2012). The USA option was computed for Cherry Blossom because it is a high density, 'smart growth' housing development.

Step 2: Estimate off-site space requirements

Off-site locations need to be large enough to accommodate Stormwater Control Measures and estimation of space requirements aids identification of potential off-site locations and mitigation costs. First, the types of SCMs allowed in an AC program were identified, and second, SCMs were sized for off-site retention volume computed in step 1.

Proposed PCRs do not prescribe specific types of SCMs or use of WMZ strategies for off-site locations therefore municipalities can tailor SCM selection to their own requirements. In this study SCMs were selected to illustrate a range of potential space requirements for runoff retention performance compliance via infiltration, retention, rainwater harvesting and evapotranspiration. Factors influencing parcel scale SCM sizing include drainage area, impervious surfaces, off-site runoff, soil type, and SCM filter media (i.e. affects storage volume void space) and depth. This planning level exercise estimated the minimum area required to mitigate the off-site retention volume computed in step 1 using the following SCMs:

- *Permeable pavement, Vegetated swale, Riparian buffer, Bioretention swale*
  Volume mitigation effectiveness of these infiltration/retention SCMs was influenced by soil infiltration rates, SCM storage volume and depth, and assumptions for acreage calculations were as follows:
    - Soil infiltration rates: soil type A, 4 inches/hour; type B, 0.75 inches/hour; type C, 0.22 inches/hour; type D, 0.06 inches/hour (VC 2001).
    - 48 hour drawdown (Appendix A, Attachment D).
    - Bioretention volume with 33% void space and depth of 3 feet (Ketley 2012).
    - Infiltration volume with 40% void space and depth of 3 feet (Ketley 2012).

- *Tree planting, Green roof, Rain barrels*
  Volume mitigation effectiveness of these SCMs was not influenced by soil type and assumptions for acreage calculations were as follows:
    - Tree planting runoff mitigation (8 cubic feet/tree) was based on tree canopy with 200 trees/acre planting density (adapted from Lawrence 2011).
    - Rain barrel runoff mitigation was based on 50 gallon/barrel storage capacity and accounted for 10% loss (adapted from Lawrence 2011).
    - Green roof runoff mitigation was based on a storage volume with 25% void space and depth of 5 inches (adapted from DCSS 2012).

Step 3: Estimate fee-in-lieu

Acreage requirements for selected SCMs computed in Step 2 were used with planning level costs to estimate off-site mitigation costs and demonstrate how a municipality might determine fee-in-lieu payments. Planning level cost data (SCM construction cost / impervious acre treated; annual operation and maintenance costs / acre) were sourced from Maryland (King and Hagan 2011) and San Francisco (SC 2010) studies but ideally, local parcel scale costs from past SCM implementation would be used.

Off-site mitigation cost estimates ($ / acre / year) and fee-in-lieu payment rate estimates ($ / gallon of off-site retention volume / year) reflected the full cost of an AC program to the municipality including pre-construction costs (e.g., cost of site discovery, surveying, design, planning and permitting), SCM construction costs (e.g., labor and materials), and post-construction costs (e.g., annual operation and maintenance) amortized over the SCM life cycle. Assumptions for off-site mitigation costs and fee-in-lieu estimation were as follows:

- Pre-construction costs were estimated to be 25% of SCM construction costs (adapted from King and Hagen 2011).
- Off-site locations would be identified on City-owned land therefore land costs were not included in pre-construction costs.
- SCMs had a life cycle of 20 years and represented the "in perpetuity" time interval.
- Fee-in-lieu was computed as an annual payment rate and a one-time payment in perpetuity (adapted from DCGB 2012).

Step 4: Identify off-site locations within City jurisdiction

Municipal fee-in-lieu programs typically use public property for off-site mitigation projects. Feasible land use types and locations are determined by the municipality and may include public right-of-ways, or city owned buildings, parks and vacant lots (e.g., vegetated swale in public ROW, building retrofit). In this preliminary study, City-owned maintained areas and parking lots were identified as feasible land use types for off-site locations in Watsonville. GIS analysis was used to ensure minimum acreage requirements were met and to prioritize potential off-site locations. GIS data included:

- City boundary, Subwatersheds, Watsonville sloughs, Land cover, Land parcels, Building footprint, Parking lots, Maintained areas, Stormwater priority locations (sourced from City of Watsonville, 2011).
- Watersheds, County boundaries, Hydrologic soil groups, Streams, Lakes, Groundwater recharge areas, Riparian woodland, Biotic areas (sourced from Santa Cruz County, 2011).
- Watershed Management Zones (sourced from Stillwater Sciences, 2012)
- National Agricultural Imagery Program (NAIP) 2009 aerial images (CaSIL 2011).

AC language in proposed PCRs states off-site projects must be within the same watershed as the regulated project but does not require off-site locations be within the same subwatershed or WMZ as the regulated project (Appendix A). To minimize environmental and socio-economic risks and maximize potential benefits, criteria for prioritization of off-site locations were (1) proximity to on-site location, (2) low cost, and (3) multiple benefits. Proximity to on-site location was determined by the distance from the development scenario and relative cost of off-site locations was estimated using SCM mitigation costs in different soil types. An assessment of benefits to a municipality is complex and depends on community needs and priorities. In this study, the proxy for multiple benefits prioritization criteria was the proximity of an off-site location to stormwater priority areas and biotic areas (i.e., proximity to these areas demonstrated an off-site location's potential for multiple benefits such as water quality and habitat improvement as well as retention volume mitigation).

Results

Off-site retention volume requirements of the two development scenarios

The 85th and 95th percentile storm events for Watsonville were 0.66 inches and 1.23 inches respectively (approximated for this study using a 30 year precipitation record). Estimation of off-site mitigation volume requirements for the Cherry Blossom and Grocery Outlet development scenarios are shown in Tables 1 and 2. Under proposed PCRs for development projects in WMZ 1 (95th percentile design storm event) it was estimated that the Cherry Blossom new development project would need to mitigate 3333 cubic feet of retention volume off-site (Table 1). Only 9 cubic feet of retention volume would need to be mitigated off-site if the location of the Cherry Blossom development was designated an Urban Sustainability Area.

Table 1: Estimation of off-site retention volume requirements for Cherry Blossom new development scenario. The off-site retention volume was 3333 cubic feet (or 9 cubic feet if within a USA). Technical constraints of type D soils qualified the project for 10% adjustment to retention requirements. The 10% adjustment decreased the off-site burden from 6508 cubic feet to 3333 cubic feet however the project had less than 10% of its Equivalent Impervious Surface Area dedicated to retention-based SCMs (the actual retention area and retention feasibility factor was estimated to be 6% and 0.78 respectively) so it is necessary for the property owner to mitigate the remaining runoff volume off-site.

Site data:	*Acres*	*Square feet*
Landscape	1.34	58,370
Buildings and Roads	2.33	101,495
Total	3.67	159,865
10% Adjustment to Retention Requirement:		
10% of Equivalent Impervious Surface Area		10,733
Actual area dedicated to retention SCMs (6%)		6,440
Portion of 10% not allocated on-site		4,293
On-site retention feasibility factor		0.78
Design Retention Volume:		*Cubic feet*
85th		7,535
95th		14,043
95th (if located in USA)		7,544
Off-site mitigation volume calculation:		
Actual runoff retained on-site		7,535
Remaining 95th design runoff that must be retained		6,508
Potential off-site mitigation retention volume		3,333
Actual off-site mitigation retention volume		**3,333**
Off-site mitigation volume if regulated project in USA:		
Actual runoff retained on-site		7,535
Remaining 95th design runoff that must be retained		9
Actual off-site mitigation retention volume		**9**

The Grocery Outlet redevelopment scenario required no off-site mitigation of retention volume under the proposed PCRs (Table 2). The redevelopment project dedicated 13% of its equivalent impervious surface area to retention based SCMs and therefore exceeded the minimum 10% requirement for a location with technical constraints (type D soil). The runoff retained by the 'extra' pervious area on-site (3080 square feet beyond the 10% requirement) was estimated to be 237 cubic feet and described as an on-site volume 'credit' (Table 2).

Table 2: Estimation of off-site retention volume for Grocery Outlet redevelopment scenario. No off-site mitigation was necessary because all of the project's post-construction landscaping was dedicated to retention based SCMs and exceeded the proposed 10% of equivalent impervious surface area requirement. The volume mitigated beyond requirements was described as a runoff mitigation credit and estimated to be 237 cubic feet.

Site data:	**Pre-existing**		**Post-construction**	
	Acres	*Square feet*	*Acres*	*Square feet*
Landscape	0.03	1,183	0.33	14,470
Roofs	0.44	19,310	0.82	35,710
Pavement	2.48	107,877	1.79	78,190
Total	2.95	128,370	2.95	128,370
10% Adjustment to Retention Requirement:				
10% of Equivalent Impervious Surface Area				11,390
Actual area dedicated to retention SCMs (13%)				14,470
Area credit (area mitigated beyond 10% requirement)				3,080
Design Retention Volume:				*Cubic feet*
85th				9,868
95th				18,391
Runoff Mitigation Credit:				
Actual runoff retained on-site using retention SCMs				9,868
Credit fraction (area credit/total area)				0.024
Volume credit (runoff retained using retention SCMs X credit fraction)				**237**

Estimation of off-site space requirements

Table 3 illustrates a range of space requirement estimates for mitigation of the Cherry Blossom off-site volume of 3333 cubic feet using different types of SCMs and soil types.

Table 3: Space required to mitigate Cherry Blossom off-site volume (3333 cubic feet) using a selection of SCMs in different hydrologic soil types.

		Space requirements (Acres)			
Stormwater Control Measures	**Mitigation type**	Soil type A	Soil type B	Soil type C	Soil type D
Permeable pavement	Infiltration	0.06	0.06	0.22	0.8
Vegetated swale	infiltration	0.06	0.06	0.22	0.8
Stream buffer	infiltration	0.06	0.06	0.22	0.8
Bioretention cell	bioretention	0.08	0.08	0.26	0.96
Tree planting	infiltration	2			
Green roof	evapotranspiration	0.73			
Rain barrel (50 gallon capacity)	rainwater harvesting	554 barrels			

Acreage requirements of permeable pavement, vegetated swales, stream buffers and bioretention cells were more than 13 times greater in type D soil than in type A soil while space requirements of tree planting, green roofs and rain barrel SCMs are not affected by soil type. If retrofitting residential houses with rain barrels used two 50 gallon barrels per house then 227 houses would be required to mitigate the 3333 cubic feet.

Estimation of fee-in-lieu

Planning level cost estimates of selected SCMs are shown in Table 4 (Note: Planning costs and fee-in-lieu estimation are meant for illustrative purposes only). The vegetative infiltration and bioretention SCMs such as swales and tree planting have similar total annual costs while permeable pavement is 5 times more expensive. The total annual cost per acre of green roof is more than 20 times the cost of vegetative infiltration and bioretention SCMs.

Table 4: Planning level cost estimates (per acre of impervious surface treated) using selected SCMs. Life cycle costs of SCMs included construction cost, pre-construction cost and annual operation and maintenance costs, and were amortized over 20 years to compute total annual costs.

Stormwater Control Measures	Construction Cost ($/Acre)	Preconstruction Cost ($/Acre)	Annual O&M Cost ($/Acre)	Life Cycle Cost ($/Acre)	Total Annual Cost ($/Acre)
Permeable pavement	$218,000	$54,500	$2,188	$316,260	$15,813
Vegetated swale	$30,000	$7,500	$931	$56,120	$2,806
Stream buffer	$30,000	$7,500	$1,210	$61,700	$3,085
Bioretention cell	$37,500	$9,375	$1,531	$77,495	$3,875
Tree planting	$30,000	$7,500	$1,210	$61,700	$3,085
Green roof	$653,000	$163,250	$32,670	$1,469,650	$73,483
Rain barrels (50 gallon capacity)	$150/barrel	$38/barrel	$250/barrel	$5,188/barrel	$259/barrel

The estimated cost of mitigating Cherry Blossom's off-site retention requirement of 3333 cubic feet using selected SCMs in different soil types is shown in Table 5. Total annual mitigation cost estimates ranged from $168 (vegetated swale located in soil type A and B) to $143,694 (554 rain barrels of 50 gallon capacity) and the estimated annual fee-in-lieu payment ranged from $0.01 to $5.77 per gallon of retention volume. Fee-in-lieu scenarios in Table 6 show various options for calculating fee-in-lieu payments. Fee-in-lieu options for the Cherry Blossom project might include an annual payment from the property owner to the City of Watsonville or a one-time payment in perpetuity. Fee-in-lieu payments can also be tailored to the expected costs of off-site mitigation. For example, the City of Watsonville may choose to use infiltration and bioretention SCMs to reflect the watershed management strategies of WMZs 1 and 4 (estimated as $0.14 per gallon of retention volume/year) or charge a higher fee (estimated as $0.22 per gallon of retention volume/year) if only type D soils are available for off-site mitigation.

Table 5: Estimated cost of mitigating Cherry Blossom's off-site retention volume requirement of 3333 cubic feet. Costs in perpetuity were computed over a 20 year time span.

	Total annual mitigation cost ($)				Cost/gallon/year		Cost/gallon in perpetuity	
Stormwater Control Measures	**Soil type A**	**Soil type B**	**Soil type C**	**Soil type D**	**min**	**max**	**min**	**max**
Permeable pavement	$949	$949	$3,479	$12,650	$0.04	$0.51	$0.76	$10.15
Vegetated swale	$168	$168	$617	$2,245	$0.01	$0.09	$0.14	$1.80
Stream buffer	$185	$185	$679	$2,468	$0.01	$0.10	$0.15	$1.98
Bioretention cell	$310	$310	$1,007	$3,720	$0.01	$0.15	$0.25	$2.98
Tree planting	$6,170				$0.25		$4.95	
Green roof	$53,642				$2.15		$43.03	
Rain barrels (50 gallon capacity)	$143,694				$5.76		$115	

Table 6: Estimation of in-lieu fees. A fee-in-lieu may be an annual payment from the property owner to the municipality or a one-time payment in perpetuity and the payment amount can be tailored to expected costs of off-site mitigation such as type of SCM used and soil constraints.

Fee-in-lieu scenarios (potential options)	Cost/gallon in perpetuity (one time payment)	Cost/gallon/year (annual payment)
Average cost/gallon of all SCMs	$24.54	$1.23
Average cost/gallon of only infiltration/bioretention SCMs	$2.81	$0.14
Average cost/gallon of only infiltration/bioretention SCMs on D soils	$4.37	$0.22
Case-by-case (range of costs/gallon) with all SCM options	$0.14-$115	$0.01-$5.77

Identification and prioritization of off-site locations

Figures 9, 10 and 11 are maps of potential off-site locations within the City of Watsonville. There are 24 acres of City owned maintained areas located in soil types B and D, distributed throughout all three subwatersheds and also located in close proximity to the Cherry Blossom development (Fig. 9). Tree planting, vegetated swales, and bioretention cells could be installed in maintained areas. There are 8.3 acres of City owned parking lots, the majority are located in the Pajaro River subwatershed on soil type B but some lots exist in the Wetlands subwatershed on soil type D in close proximity to the Cherry Blossom development (Fig. 9). Permeable pavement is a typical SCM installed in parking lots but this type of mitigation has high cost per acre and is more costly on soil type D than soil type B (Table 5).

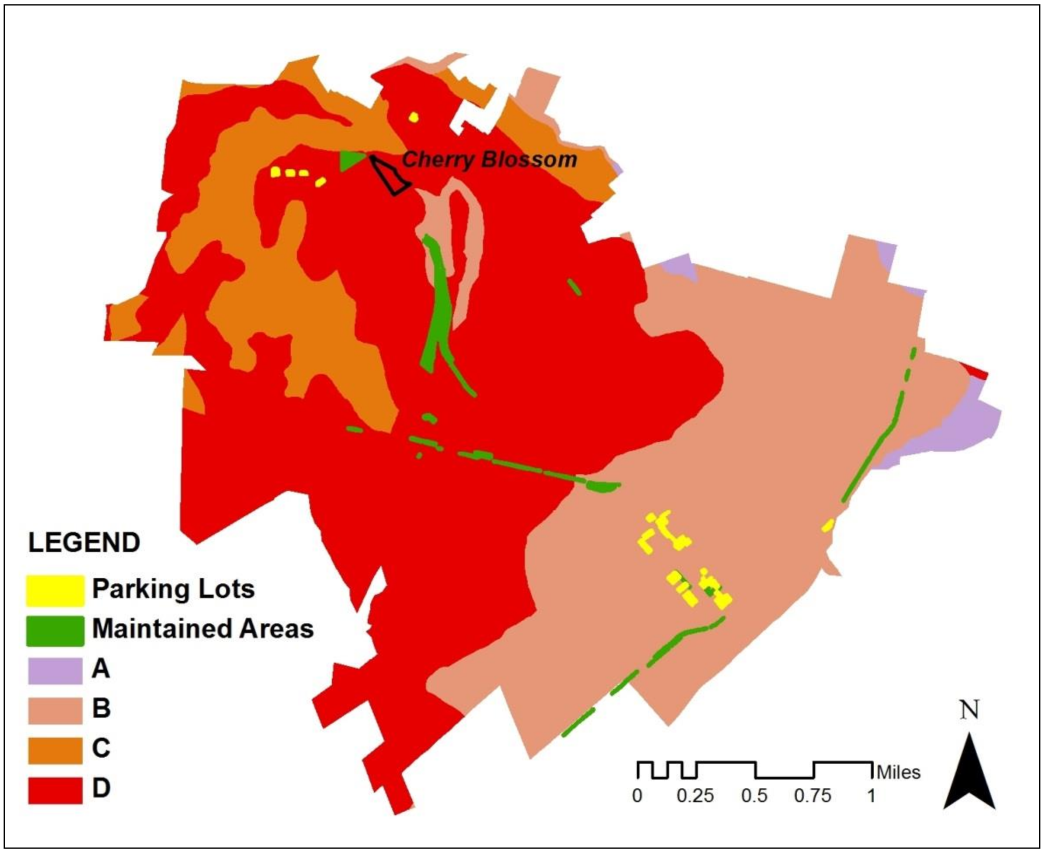


Figure 9: Distribution of potential off-site locations within the City of Watsonville hydrologic soil types. City-owned parking lots and maintained areas are considered feasible land use types for off-site mitigation. The map can be used to identify off-site locations in close proximity to Cherry Blossom development, meet space requirements and predict mitigation costs.

The infiltration and bioretention SCMs proposed for Watsonville off-site locations have dual benefits of mitigating runoff volume and pollutants. Figure 10 illustrates other potential water quality benefits of the selected off-site locations such as proximity to stormwater priority locations, biotic resources, and waterbodies.

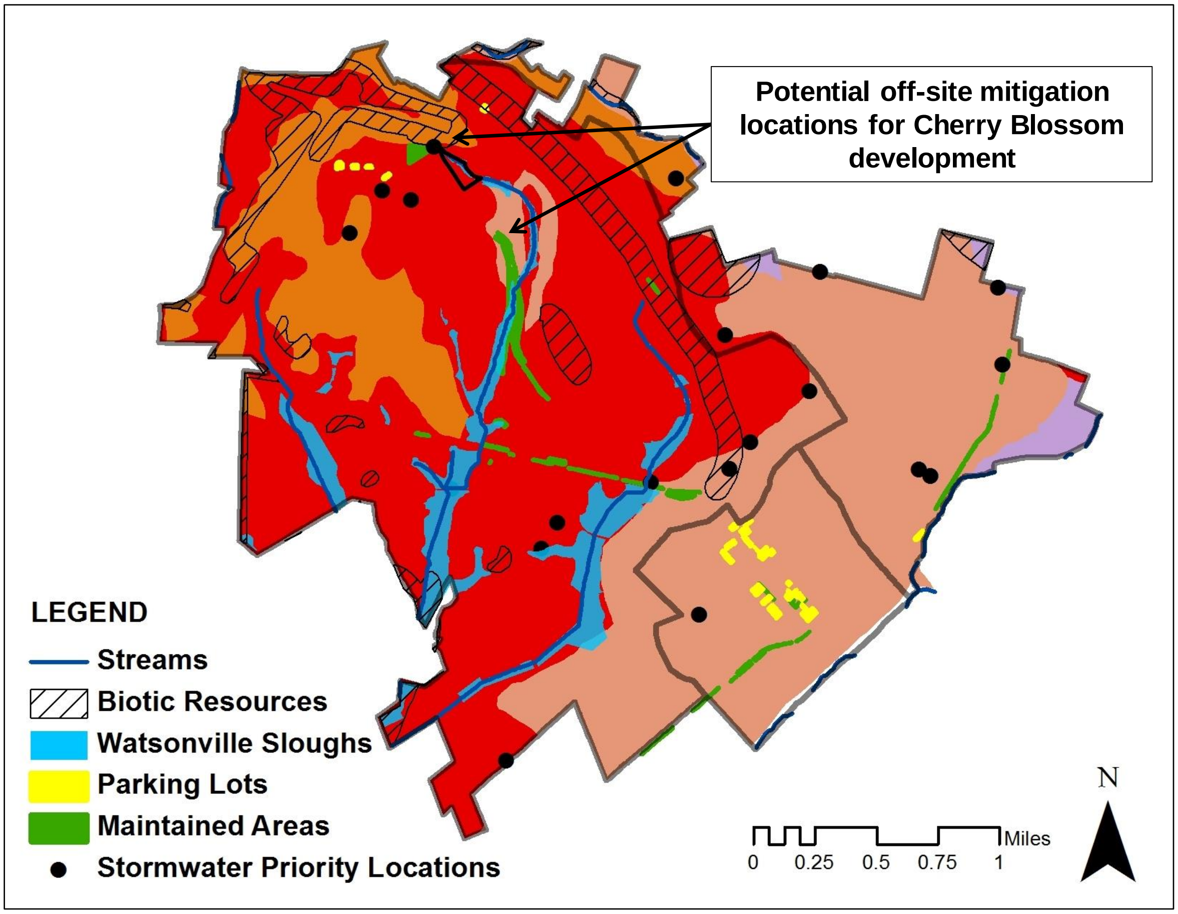


Figure 10: Map of off-site locations (City owned parking lots and maintained areas) and potential water quality benefits in the City of Watsonville. Two locations were selected as the best sites for mitigation of Cherry Blossom off-site retention volume due to their proximity to Cherry Blossom development, low cost (i.e., soil types B and C have lower mitigation costs than soil type D), and potential for multiple benefits (i.e., proximity to waterbodies, biotic resources and stormwater priority locations (Note: Stormwater priority locations illustrated in Fig. 10 do not reference actual priority sites in Watsonville).

Two locations, site #1 and #2, identified in Figs.10 and 11 meet off-site location prioritization criteria of proximity to on-site development, low cost, and multiple benefits. Site #1 is 0.1 acres and meets minimum space requirements for a vegetated swale or bioretention cell on soil type B (refer to Table 3). Construction costs at Site #1 are likely to be low due to the choice of SCM and soil type and on-going maintenance costs will be minimized because the area is already maintained by the City. Site #1 is in close proximity to the Cherry Blossom development and both sites drain to the same waterbody (a tributary of Watsonville Slough) therefore the environmental risk of off-site mitigation is reduced. Site #2 is 2 acres and meets minimum space requirements for the selected infiltration and bioretention SCMs on soil type C (refer to Table 3). The site is not a parking lot or maintained area but is located on City owned property (Watsonville airport) adjacent to a maintained area. Mitigation would be more costly at Site #2 than Site #1 due to the increased space requirements of soil type C and/or choice of SCM (e.g., tree planting) however the location was selected due to its close proximity to the Cherry

Blossom development and potential for multiple benefits such as water quality improvement and biotic resource enhancement.

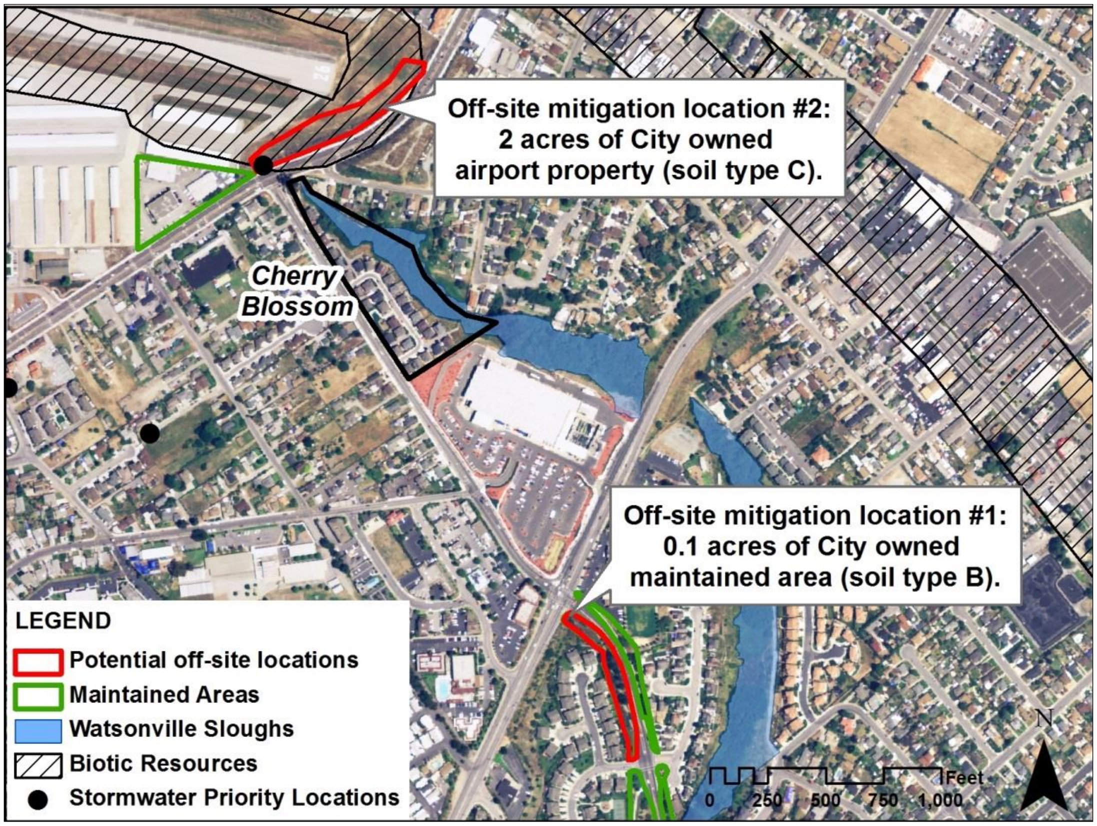


Figure 11: Site details of the two locations selected to mitigate Cherry Blossom's off-site retention volume. Site #1 is a narrow strip of maintained area situated between houses and a road and the location is suitable for a vegetated swale or bioretention cell. Location #2 is a wider area situated between airport facilities and a road. The location is a biotic resource area and stormwater priority location and suitable SCMs may include tree planting to enhance biotic resources or a bioretention cell to mitigate off-site volume and improve water quality (Note: Stormwater priority locations illustrated in Fig. 11 do not reference actual priority sites in Watsonville. Also, considerations such as protected plant species and Federal Aviation Association rules may constrain tree planting and other suggested SCMs at off-site location #2).

Discussion

Retention volume estimates for the two development scenarios (Tables 1 and 2) suggest some development projects in the City of Watsonville will require off-site compliance options but only small amounts of runoff may need to be mitigated. Municipalities in Contra Costa County have reported similar off-site compliance needs (Inglis 2012). City of Watsonville results indicate small scale mitigation projects, either 1:1 or aggregate projects, would be more suitable for their fee-in-lieu program than large regional projects.

It was expected both development scenarios, Cherry Blossom and Grocery Outlet, would require off-site mitigation of retention volume due to their location in low infiltration type D soils. However the ten percent adjustment rule for technical infeasibility provided in the proposed PCRs (CCPCR 2012) significantly reduced retention requirements. Additionally, if the Cherry Blossom development was designated in a USA then virtually no off-site mitigation would be necessary (Table 1). Cherry Blossom's high density housing is the type of development municipalities want to encourage but USA designation may be unlikely because it is not located near the downtown area. Restricting USAs to downtown areas may be counterproductive for communities with an urban limit line (i.e., the boundary marking the outer limit where development can occur) (Ketley 2013). For example, municipalities with limited space and high growth rate may face economic and social pressure to abandon limit lines and pursue sprawl if all their infill areas (in downtown and elsewhere) are not designated USAs. Promoting 'smart growth' is an important objective however allowing all infill areas to be designated USAs may also provide a loophole for developers to avoid treating runoff on-site to the MEP.

The range of space requirements and mitigation costs in Tables 3 and 5 demonstrate the potential impact SCM selection and soil infiltration have on SCM cost effectiveness. Space requirements of rain barrels and green roofs are independent of soil type but their mitigation costs were much higher than the most expensive retention/infiltration SCM on soil type D and they do not provide the same degree of benefits such as water quality treatment and replication of watershed processes. Proposed PCRs do not specify off-site locations must use WMZ management strategies however Tables 3, 4 and 5 suggest adopting WMZs 1 and 4 retention/infiltration requirements at Watsonville's off-site locations may not only provide more environmental benefits but also the least costly mitigation strategy.

Site-specific constraints to consider when selecting SCMs for an AC program include implementation feasibility on the available land (e.g., City owned parking lots, maintained areas, ROWs, vacant lots, parks, buildings), site shape (refer to Fig. 11) and slope (not considered in the study because Watsonville jurisdiction is mainly flat). There are also less obvious site constraints to consider. For example, the off-site location #2 (Fig.11) is on airport property therefore SCMs must comply with Federal Aviation Administration guidelines (e.g., tree height near an airstrip). Off-site location #2 also has protected plant species which cannot be removed to accommodate SCM installation.

A key regulatory issue for AC programs is the definition of 'Maximum Extent Practicable', the statutory standard for SCM implementation. The ten percent limit, the upper boundary on site area dedicated to retention based SCMs established in proposed PCRs, provides a clear point of compliance (i.e., MEP) for technically constrained sites (Appendix A). Watershed plans and USAs may be used to justify alternative compliance for regulated projects without demonstrating technical infeasibility however projects using these AC options must still meet retention performance requirements to the MEP and the ten percent limit is not necessarily applicable. Municipalities could potentially raise the ten percent limit or use construction costs to establish

MEP for regulated projects which don't meet criteria for technical infeasibility. For example, in the Santa Clara Valley hydromodification management plan, matching pre-project runoff rates is considered 'impracticable' on-site if the overall cost of SCMs exceeds 2% of project construction costs (SCV 2005).

It was estimated the Grocery Outlet development scenario retained more runoff on-site than required and the overage (the volume retained by SCMs beyond MEP) was called a retention volume 'credit' (Table 2). Washington DC retention credit trading program allows private property owners to sell their 'credits' to other private property owners that require off-site compliance (DCGB 2012). The Grocery Outlet results suggest there is potential for private/private trading in Watsonville however low demand for off-site mitigation, high transaction costs (e.g., cost of identifying willing property owners and brokering the trade), and difficulty establishing MEP at some sites may limit trading feasibility.

Sizing of retention/infiltration SCMs (e.g., acreage, storage volume) is typically influenced by characteristics such as soil type, impervious land cover, slope, and off-site runoff. In the study, off-site retention volume was known (i.e., 3333 cubic feet estimated from the Cherry Blossom on-site development), actual off-sites location were unknown, and soil type provided a simple planning level assessment tool to estimate minimum space requirements for retention/infiltration SCMs (Table 3). Equations from spreadsheet models were used to estimate space requirements for SCMs not dependent of soil type such as green roofs, rain barrels and tree planting (DCSS 2012; Lawrence 2011). When the actual off-site location is known, project-scale sizing of SCMs can be determined using hydrologic analysis. For example, TR-55 is a runoff curve number and unit hydrograph method widely used by municipalities to model SCMs for single event storms (LID 2010; Ketley 2012). Spreadsheet models (e.g., Washington DC credit trading spreadsheet) have been developed for AC programs to calculate runoff volume reduction 'credit' using inputs from off-site location characteristics including SCM acreage, land cover, soil type, drainage area, and SCM storage volume and acreage (DCSS 2012).

In an actual AC program, off-site locations are selected and then runoff volume 'credit' is calculated from off-site location's characteristics and SCM selection and sizing. To receive volume credit off-site locations typically must achieve retention in excess of stormwater management requirements (i.e., beyond MEP for regulated projects; in excess of existing retention for unregulated projects) (DCGB 2012). Off-site locations on public property are typically unregulated projects such as right-of-ways or retrofits of existing building or parking lots. In the study, two potential off-site locations were selected (Fig. 11) and the next step in an AC program would be to determine runoff volume of sites #1 and #2 before and after SCMs implementation, to determine if they have the capacity to retain 3333 cubic feet (i.e., the required volume credit) in excess of their pre-existing retention conditions. Municipalities may use a simple spreadsheet model, single event hydrologic analysis, or a more complex continuous simulation hydrologic model to select SCMs and determine retention volume 'credits' at off-site locations.

Proposed PCRs state the location of an off-site project must be within the same watershed as the regulated project (Appendix A). The City of Watsonville is located in the Pajaro River watershed which is 1300 square miles and comprises portions of four Counties (Santa Cruz, Monterey, Santa Clara, and San Benito). A watershed-wide fee-in-lieu program may be difficult to implement due to the complexity of multiple County jurisdictions whereas approval and implementation off-site projects located within the City boundary are controlled by the municipality.

Prioritization criteria for potential off-site locations can be designed by a municipality to meet specific community needs, optimize locations of fee-in-lieu projects, minimize risks associated with AC and maximize potential benefits. For example, proximity to an on-site location may reduce the risk of erosion or flooding problems near unmitigated developments. Cost of off-site mitigation was used to prioritize potential locations in order to improve cost effectiveness, reduce financial burden of AC on municipality and developer, and reduce the risk of underfunding off-site projects. Long term maintenance costs of SCMs (refer to Table 4) may be reduced by locating off-site projects in areas that are already maintained by the municipality (e.g., Watsonville's maintained areas), provide opportunity for citizen involvement (e.g., green street projects in public ROWs), or have available acreage for an aggregate off-site mitigation project (i.e., mitigation of more than one development project). The potential of an off-site project to achieve multiple benefits was also used to prioritize locations and criteria for multiple benefits can be tailored to community needs. For example, installing off-site projects at stormwater priority locations has the potential to target water quality issues as well as treat off-site retention volume (Fig. 10).

The criteria for prioritization of off-site locations (i.e., proximity to on-site location, low cost, and multiple benefits in this study) could be weighted to tailor an AC program to watershed and community needs. For example, if the primary issue was economic then the cost of the off-site project may be given more weight than the ability of the project to provide multiple benefits or the proximity of the project to the on-site location. On the other hand, if the primary issue in the watershed was restoration of riparian habitat then off-site projects which can provide this benefit may be given more weight than projects which are low cost or close to on-site location. A weighting methodology to prioritize off-site locations may affect the fee-in-lieu estimation (e.g., fewer SCMs options may facilitate the matching of fee rates with actual mitigation costs) as well as the identification of off-site locations.

Net environmental benefits from off-site mitigation occur when benefits are achieved that would not otherwise have occurred under normal compliance requirements. The type of land used for off-site mitigation and the location within the watershed influence the ability of SCMs to achieve net benefits. For example, off-site bio-retention SCMs installed in a busy parking lot will treat more pollutants (e.g., car oils) than the same SCMs installed at an on-site residential development. In the City of Watsonville, off-site volume retained at a parking lot in the Pajaro River subwatershed will drain to the Pajaro River and may have less retention and water quality benefit (e.g., due to the extensive drainage network, size of the river, river levees) than retaining the same volume in a parking lot in the Wetlands subwatershed which drains to the Sloughs (refer to Fig. 10). In this case, cost-benefit analysis of the off-site mitigation would need to consider the trade-offs between water quality and retention benefits in the Wetland subwatershed and project cost on soil type D. TMDLs in the Pajaro River and Watsonville Sloughs would also be a factor in cost-benefit analysis if the off-site locations were a pollutant source for listed impairments and the SCMs had the ability to effectively treat those pollutants.

Watershed priorities as well as site-specific requirements are important considerations for optimizing SCMs benefits and costs. AC options also need to demonstrate, using quantifiable methods of analysis, that implementation of the chosen SCMs will be as effective in maintaining watershed processes as implementation of on-site requirements (Appendix A). SCMs with readily quantifiable benefits were used in this analysis however other, less easily quantifiable SCMs may provide greater benefits to Watsonville. For example, watershed priorities for the Watsonville area include pathogen and nutrient TMDLs in surrounding waterbodies, and stream restoration. Stream restoration projects have been quantified in terms of runoff reduction using complex methodology (WVDEP 2012). Treatment wetlands have been used to reduce pathogen and nutrients pollutant loads however this 'out-of kind' SCM are typically not given runoff reduction 'credit' in stormwater AC programs (DCSS 2012).

Trading ratios could be used to maximize net benefits and reduce risk of inadequate mitigation. The estimation of SCM size requirements at off-site locations assumed a 1:1 basis for on-site and off-site retention volumes and, besides the prioritization criteria, the study did not account for the distance between the off-site location and the regulated project that could affect water quality. This may lead to inadequate mitigation, particularly in environmentally sensitive locations. For example, a regulated project which requires off-site mitigation but is located in close proximity to Salsipuedes Creek may need to mitigate for more than the computed off-site retention volume to achieve ecological 'equivalency' (e.g., to account for high risk of stream bank erosion from unmitigated runoff at the regulated site), particularly if the off-site project is located upstream or further away from Salsipuedes Creek and cannot provide the same ecosystem services. A municipality could possibly set higher trading ratios, requiring more mitigation for high risk locations, to serve as a margin of safety and potentially a disincentive for pursuing AC.

The study did not account for lag time between the generation of volume credits at the off-site location and use of the volume credits at the regulated site. Proposed PCRs state the off-site project should be completed as soon as practicable and no longer than four years after completion of the regulated project (Appendix A), and some off-site SCMs such as tree planting may take years before they reach full effectiveness. Trading ratios could be used to account for lag time between the construction of development projects and completion of mitigation projects.

Figures 9, 10 and 11 illustrate potential off-site locations exist in the City of Watsonville but the long term availability of cost effective off-site mitigation (refer to Tables 5 and 6) may be limited by the heavy clay soils which commonly occur within the municipality. Another AC option is to pursue off-site mitigation outside the City jurisdiction to improve the potential for watershed-scale environmental benefits and provide the best 'bang for the buck'. Approximately 100 square miles of Santa Cruz County (including 6.5 square miles of City of Watsonville) is situated within the Pajaro River watershed. The Central Coast Regional Water Quality Control Board believes protecting watersheds, including groundwater recharge areas, aquatic habitat and riparian buffer zones will have the greatest impact on water quality improvement in the region over the long term (CCRBPTR 2009). Fig. 12 shows no recharge areas and very little riparian woodland exist within the City jurisdiction but upstream of the City there are potential locations for groundwater recharge and riparian buffers within the Corralitos-Salsipuedes Creek subwatershed in Santa Cruz County.

County off-site projects could be developed as part of a watershed plan. Watershed and regional plans are an AC option that allows regulated projects to use AC without demonstrating technical infeasibility (Appendix A). The administration of the projects may be more difficult due to City-County or municipality-municipality jurisdictional boundaries. For example, agreements such as memorandums of understanding (MOUs) or Joint Powers Authority (JPA) may need to be established between governing entities to address exchange of funds, liability, and maintenance responsibilities. However, there is potential for net environmental benefits, particularly runoff retention and groundwater storage, in a watershed approach. For example, the City and County area share the same groundwater basin therefore the groundwater recharge projects outside the City boundary still benefit the municipality, and riparian buffers installed upstream of the City may help the municipality achieve water quality and retention goals. Also, soil types A and B are common outside the City limit so there is greater potential for cost effective mitigation. Ideally, fee-in-lieu projects outside the City would be located on County-owned land however many riparian areas are located on agricultural land and may require the purchase of easements, decreasing project feasibility. Santa Cruz County Land Trust has purchased easements to improve water quality in Watsonville Slough and the City and County could potentially collaborate with the Land Trust to help with fee-in-lieu projects in the Corralitos-Salsipuedes Creek subwatershed (LTSC 2012).

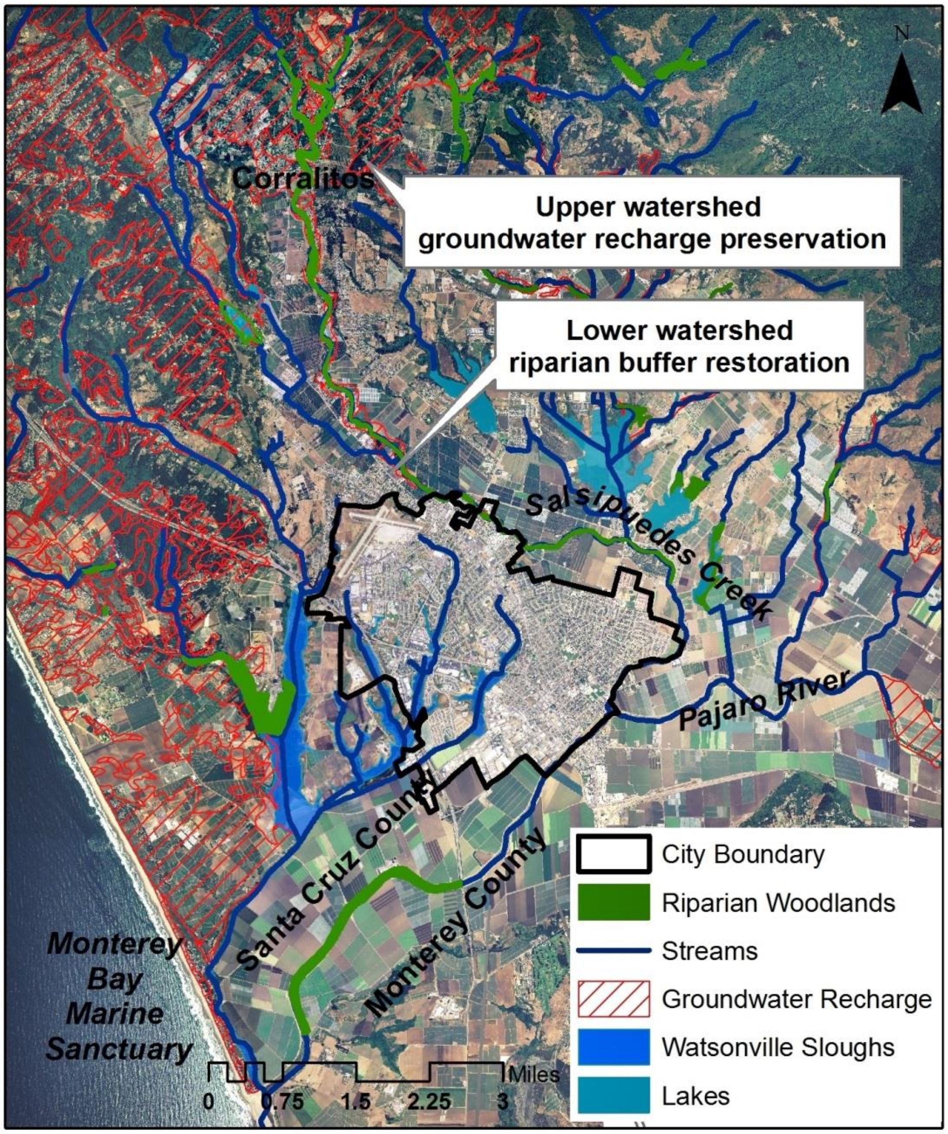


Figure 12: Aerial view of the City of Watsonville and a portion of the Pajaro River watershed. Groundwater recharge and riparian areas are priority locations for improving water quality and groundwater storage in the Central Coast Region but no recharge areas and very little riparian woodland exist within the City jurisdiction. Upstream of the City, recharge and riparian areas within the Corralitos-Salsipuedes Creek subwatershed are potential locations for off-site mitigation projects such as preservation of groundwater recharge areas and restoration of riparian buffers.

Fee-in-lieu rates (Table 6) were estimated using planning level SCM costs such as construction, pre-construction, and annual operation and maintenance costs, amortized over a 20 year life cycle (Table 4). The objective of the exercise was to demonstrate how a municipality might calculate fee-in-lieu payments however an actual fee-in-lieu should reflect local costs and conditions to more accurately predict an average mitigation cost for a municipality or watershed. For example, the District of Columbia retention credit trading program in-lieu fee is

$3.50 per gallon per year (DCGB 2012). The fee represents the full life cycle cost to retain one gallon of stormwater for one year and includes project planning, project design, project management, construction and installation, operation and maintenance, as well as project financing, land acquisition, administration of in-lieu fee program and legal support for the program (DCGB 2012). In the study, a similar fee rate was estimated using green roofs ($2.15 per gallon per year) and rain barrels ($5.77 per gallon per year) but the fee estimate for infiltration and bioretention SCMs was much less ($0.14-$0.22 per gallon per year) (refer to Tables 5 and 6). Unlike the study fee estimates, the District of Columbia fee included land cost and their highly urban, space constrained environment may have limited their SCMs choices to green roofs or require the purchase of land for infiltration/retention SCMs.

The study estimated in-lieu fees both as annual payments and one-time payments (Tables 5 and 6). Fee-in-lieu programs are typically funded by on-site property owners paying a one-time fee to cover off-site mitigation in perpetuity. Once the fee payment is made a property owner has no further compliance requirements and off-site mitigation responsibility shifts to the municipality. The District of Columbia retention credit trading program uses a different approach by funding off-site projects with annual payments from on-site property owners (DCGB 2012). The annual payment requirement stays with the property, is transferred to each subsequent property owner, and remains in perpetuity until the property owner upgrades their SCMs and mitigates all required volume on-site. Compared to the typical one-time payment in perpetuity, the annual payment approach: may reduce a municipality's financial risk of underfunding projects in the long term; provides incentive to the on-site property owner to eventually upgrade SCMs and mitigate all required runoff on-site; allows for future innovation in SCMs to be incorporated into post-construction developments (i.e., reduces future need for publicly funded retrofits); and is more equitable to property owners as they only pay for off-site mitigation when they own the property not for future mitigation.

There are pros and cons of an in-lieu fee and its estimation methods. An advantage of a single predetermined fee rate (i.e., a prediction of average cost per gallon of off-site retention volume using selected SCMs and land type) is that it allows property owners/developers to know and plan for mitigation costs in advance. In the study, the fee was estimated using on-site mitigation requirements and projected costs of off-site projects therefore the fee is socially equitable as all property owners/developers pay the same rate and the total fee is proportional to their mitigation effort on-site (although property owners with sites in environmentally sensitive areas may be penalized if trading ratios are applied to the in-lieu fee). In comparison, a case-by-case approach does not require a municipality to predict an average cost of off-site mitigation and property owners requiring off-site mitigation may pay different rates depending on off-site project timing and availability. This approach does not allow property owners to plan for mitigation costs and is not an equitable solution however it may reduce municipality financial risk of underfunding the more expensive off-site projects. Another method for establishing a developer's contribution to off-site projects could be based on construction costs of an on-site project. This approach seems inequitable as it is not based on on-site mitigation performance. It may help establish an MEP standard for SCMs implementation at regulated sites but it is not linked to cost of off-site mitigation and therefore increases municipal financial risks.

The different types of costs involved with off-site mitigation (refer to table 4) and the broad range of costs across different fee-in-lieu options (Tables 5 and 6) highlighted the difficulty of choosing a single fee-in-lieu rate. Unless the type of SCMs and location of off-site projects are planned in advance, there is a risk of underestimating required fees and thus underfunding some off-site projects. Using a limited set of SCMs with known costs for off-site mitigation projects may minimize the financial risk.

The fee-in-lieu approach demonstrated in the study would require all developers/property owners within a municipality to pay the same fee rate ($/gallon) no matter what type of off-site project is chosen by a municipality to the mitigate retention volume. Some municipalities may be interested in using in-lieu fees to fund priority projects they consider crucial for their watershed health but are constrained to do so when projects utilize non-retention-based SCMs or non-structured SCMs which may be considered 'out-of-kind' projects. Regional Water Quality Control Boards have authority to grant municipalities more discretion in their use of in-lieu fees for targeting stormwater priorities in their watershed. This option is hinted at in some NPDES permits, for example, acceptable off-site projects in the Ventura County NPDES permit include wetland restoration (CWBLAV 2010). CCRWQB's proposed PCRs suggest that all mitigation projects must be quantified into standard retention units such as volume of stormwater or area of impervious surface. More research is needed to improve the ability to translate different ecosystem services into runoff reduction units because in some circumstances, 'out-of-kind' projects may provide the most cost effective benefits for long term watershed health.

Conclusion

Study results indicate some development projects in the City of Watsonville may need off-site compliance options to meet proposed PCRs however only small amounts of runoff mitigation may be necessary. It was estimated the Cherry Blossom new development project (3.7 acres of high density residential housing on soil type D) would need to mitigate 3333 cubic feet of runoff off-site, and only 9 cubic feet if the development project was located in an Urban Sustainability Area. It was estimated the Grocery Outlet project (3 acres of commercial redevelopment on soil type D) would not need to mitigate any runoff off-site and actually retained more runoff on-site than required.

Utilizing City owned property for off-site mitigation seems feasible. Off-site locations were selected from City owned land and prioritized according to criteria such as space requirements, proximity to on-site development, low cost, and potential for multiple benefits. The study identified two locations which met criteria for Cherry Blossom's off-site mitigation. The locations had soil types B and C and were suitable for infiltration and bioretention SCMs which helped reduce mitigation acreage requirements and costs, and they also drained to the same area as the Cherry Blossom development, minimizing risk of inadequate mitigation and 'hot spots'. However, the major presence of soil type D within the City jurisdiction may limit cost effective off-site options within Watsonville. A watershed approach which also targets priority mitigation areas outside the City jurisdiction, such as groundwater recharge areas and riparian buffers, may deliver the most environmental benefits and cost effective mitigation for the municipality.

Fee-in-lieu rates were estimated using planning level SCM life cycle costs such as construction, pre-construction, and annual operation and maintenance costs. Fee-in-lieu options included annual payments, one-time payment in perpetuity, and computing cost per gallon rates by averaging all SCM costs or a selection of SCMs tailored to municipal conditions (e.g. soil constraints, SCM mitigation type). The broad range of costs across different fee-in-lieu options highlighted the difficulty of choosing a single fee-in-lieu rate and the risk of underfunding off-site compliance projects. Methodology demonstrated in the study may help municipalities identify potential off-site locations in advance and more accurately predict future off-site mitigation costs using local cost data to reduce financial and compliance risk.

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