

CITY OF CHARLOTTE COST ANALYSIS - REVISION 1

CITY OF CHARLOTTE

LANDDESIGN

US INFRASTRUCTURE OF CAROLINA, INC

TIMMONS TIMBERS, INC

SHARPE IMAGES

AUGUST 2007



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# 1

## EXECUTIVE SUMMARY

PROJECT OVERVIEW

RESULTS SUMMARY

DRAFT ORDINANCE/POLICY DISCUSSION



The City of Charlotte is expected to grow by approximately 350,000 people over the next 25 years. The City is engaged in assessing a series of initiatives intended to ensure that continued growth can be accommodated in a sustainable fashion. Initiatives include the creation of the following: The Environmental Chapter of the City of Charlotte's General Development Policies (GDP-E), the Urban Street Design Guidelines (USDG), and the Post Construction Controls Ordinance (PCCO). The GDP-E is a policy document intended to provide direction for future growth that fosters continued economic development while ensuring that the potential negative environmental impacts associated with that growth can be minimized. The policies proposed in the GDP-E will be implemented through a wide variety of activities, including making changes to existing regulations, practices and processes, and developing new regulations, practices and processes. The PCCO and the USDG represent two major tools for implementing the policies contained in the draft GDP-E.

This report summarizes potential site-level costs of implementing these initiatives as currently drafted (particularly in combination with one another or individually as may be necessary).

The City of Charlotte Cost Analysis project evaluates four separate, existing developments to varying levels of ordinance implementation. Design examples include sufficient detail to estimate the site-specific expenses incurred by implementing more protective and infrastructure improvements, as specified in the PCCO and USDG respectively. Costs are compared with the current approved design. The cost estimates are limited to the specific costs of the land development associated with each project. No ongoing maintenance costs are estimated, nor are "soft" costs (such as engineering and legal fees) associated with reduced project yields or land value estimates included in the scope of this project, except as provided with the proforma analysis in the single family residential section. However, those costs are recognized as a component of the overall economic effect of any change in development

standards for the specific sites. Furthermore, these costs were developed with the assumption that all other aspects of the specific developments were held as constant as possible for comparison to the actual approved developments.

Previous to this project, rough cost estimates were prepared. These costs represented "rule of thumb" construction costs required to meet ordinance revisions. The purpose of this cost analysis project is to better define the costs to new development and redevelopment of varying land uses and locations within the City. Although the cost estimates developed through this analysis will be site specific, they represent much more detail than has been provided previously. The costs calculated as part of this analysis are compared with the approved design according to existing regulations at the time of plan approval.

From a theoretical standpoint, determining the impact, benefit and cost of implementing more protective development standards versus not implementing can be difficult to quantify because most of the impacts, benefits and costs are very subjective. Unfortunately, the actual cost is not fully determined until the new standard is adopted and work is completed in accordance with that standard. Typically, more protective development standards add cost to development.

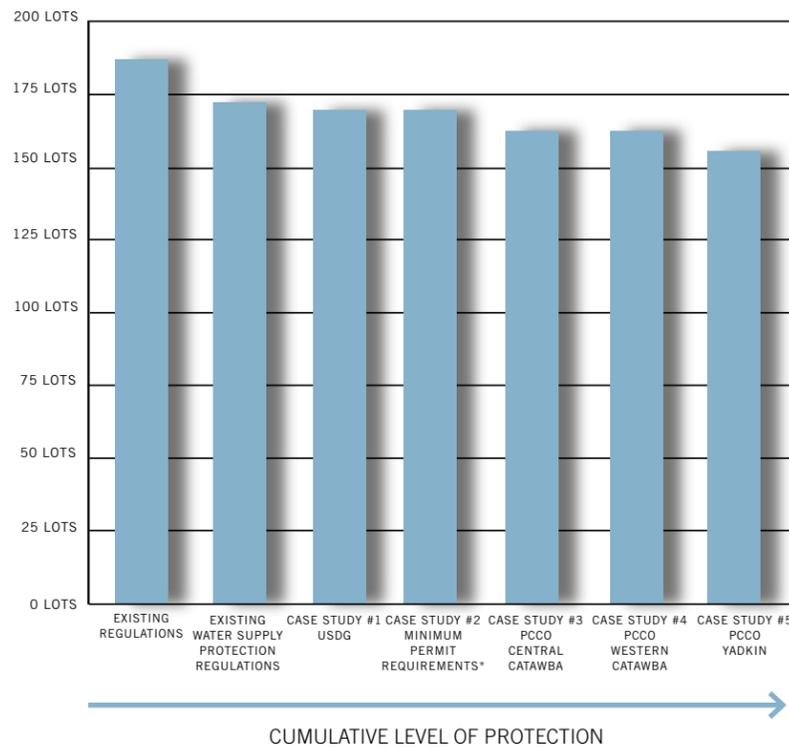
Although this report provides for the direct costs of incorporating the standards of the draft ordinances being evaluated, it is recognized that there are costs and benefits associated with the adoption of more protective development standards that have not been quantified with this analysis. However, they are recognized as an important factor in the decision to implement such ordinances or a version thereof. This cost information, together with consideration of the area-wide, long term implications of not implementing such policies will assist staff and elected officials in refining, finalizing and implementing the above-referenced ordinances and policies to effectively meet the community's goals.

### SINGLE-FAMILY RESIDENTIAL

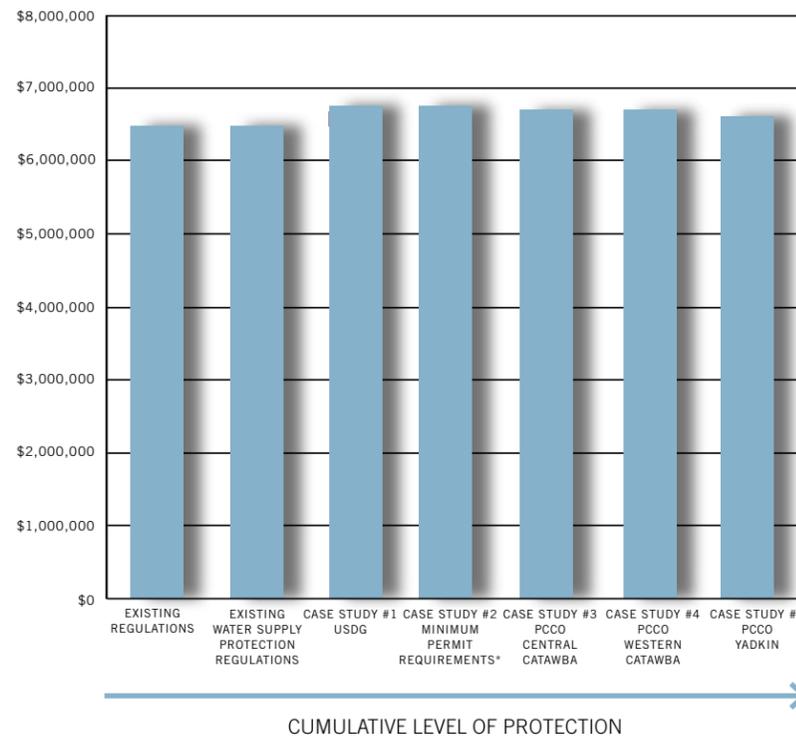
TOTAL ACREAGE: 51.9 ACRES

TOTAL DEVELOPMENT VALUE: APPROXIMATELY \$50 MILLION

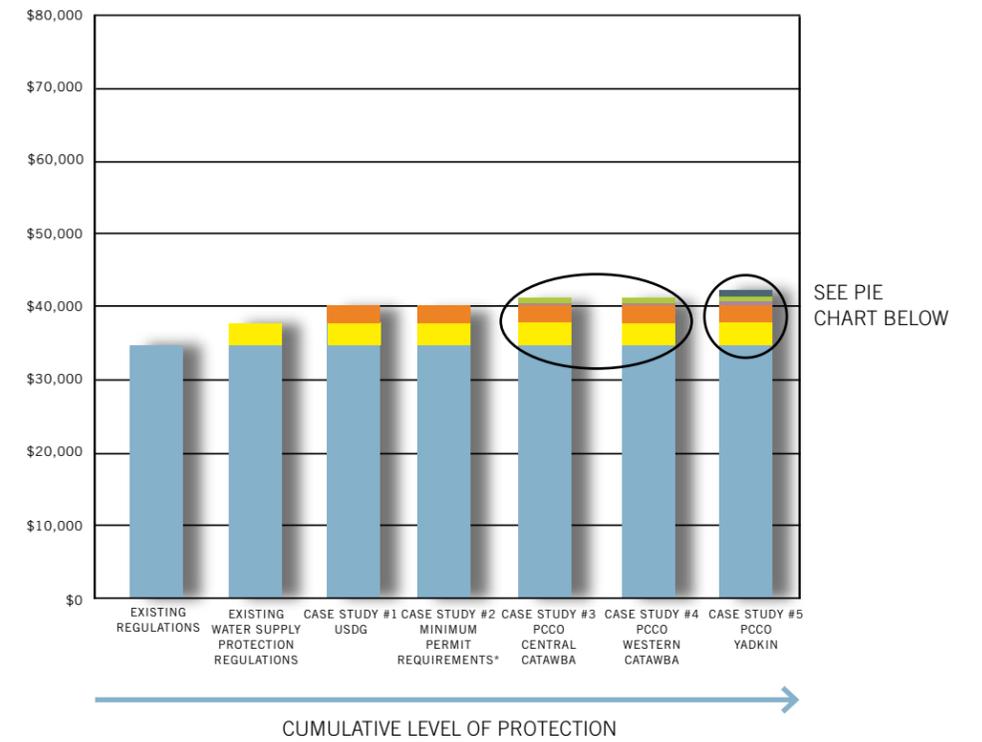
**SINGLE FAMILY INFRASTRUCTURE LOT YIELD**



**SINGLE FAMILY INFRASTRUCTURE COST**

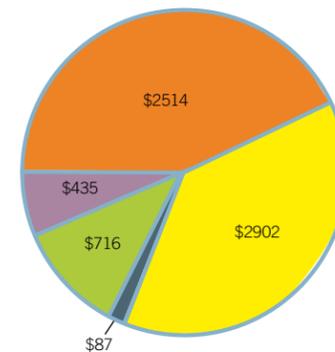


**SINGLE FAMILY INFRASTRUCTURE COST PER LOT**

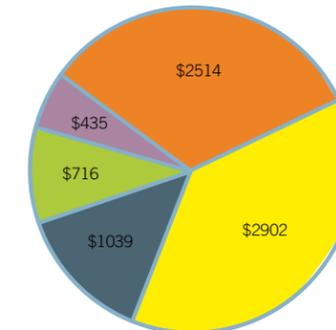


- USDG is included in Case Studies 2-5 and the proposed regulations are additive and build upon the regulations in the previous case study.
- Increased regulations resulted in more street connections, enhanced structural storm water controls, additional undisturbed open space, and expanded stream buffer protection.
- The Single Family case studies were affected by the USDG because an increase in net linear footage of streets resulted in a decrease in the developable property.
- The Single Family case studies were affected by the draft PCCO because increases in open space requirements and buffers caused a decrease in the developable property or lot yield.
- Home sales under existing regulations ranged from approximately \$200,000 to \$350,000.
- The reduction of developable property was minimized by using the mitigation option for open space on individual lots rather than in common areas.
- Lot yield reduction going from Existing Regulations to meeting Minimum Permit Requirements is 8.1% or 15 lots.
- The USDG reduced lot yield by an additional 1.8% or 3 lots.
- Applying requirements in the most sensitive watersheds resulted in an additional lot reduction of 6.5% or 13 lots above Minimum Permit Requirements\*.
- \*See Appendix for definitions

**INFRASTRUCTURE COST PER LOT INCREASE OVER EXISTING REGULATIONS IN THE CENTRAL & WESTERN WATERSHED DISTRICTS (77% of City)**



**INFRASTRUCTURE COST PER LOT INCREASE OVER EXISTING REGULATIONS IN MOST SENSITIVE WATERSHEDS (23% of City)**

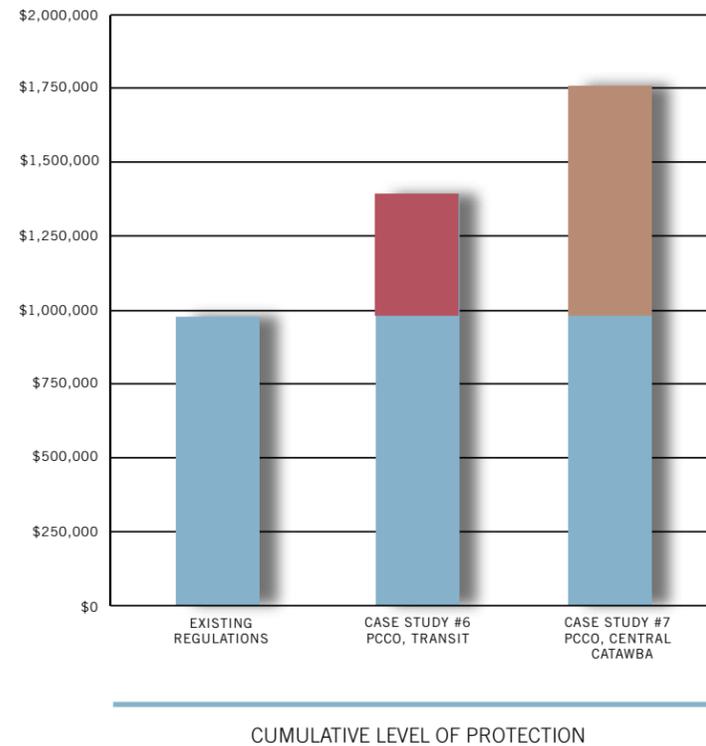


## URBAN INFILL

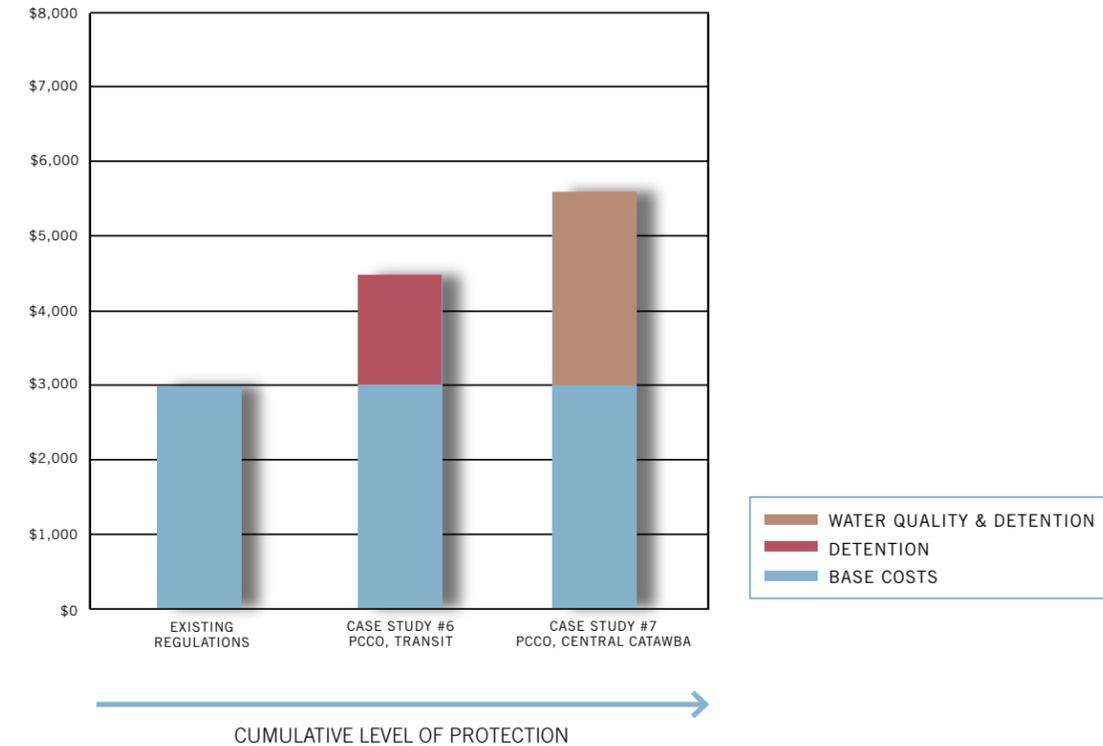
TOTAL ACREAGE: 2.87 ACRES

TOTAL DEVELOPMENT VALUE: APPROXIMATELY \$75 MILLION

**URBAN INFILL INFRASTRUCTURE COST**



**URBAN INFILL INFRASTRUCTURE COST PER UNIT**



■ WATER QUALITY & DETENTION  
■ DETENTION  
■ BASE COSTS

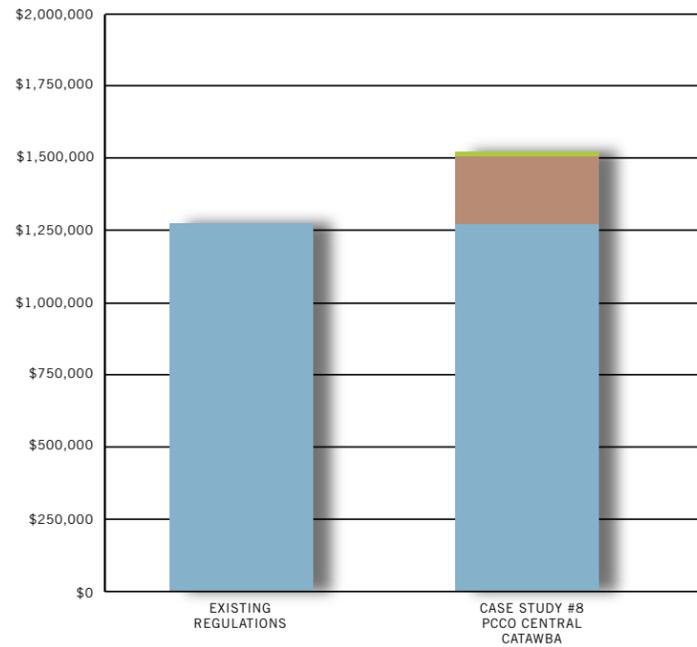
- The Urban Infill case studies site is located in a Transit Station Area. Case study 6 made use of draft ordinance provisions that reduced costs for Economically Depressed and Transit Station Areas.
- The Urban Infill case studies are not affected by the requirements of the USDG as there are no new public roadways proposed.
- The Urban Infill case studies are not affected by the Minimum Permit Requirements\* because the existing site was largely impervious and the approved plan reduced impervious area.
- The Urban Infill case studies are affected by the draft PCCO because underground storm water measures were introduced.
- The projected value of this development is approximately \$75 million. Costs increased \$475,000 or 0.6% to meet the requirements of the draft PCCO.
- Provisions in the ordinance to eliminate the undisturbed open space and water quality requirements for redevelopment projects in Transit and Economically Depressed Areas are included to offset additional costs of redevelopment.
- \*See Appendix for Definitions

### MULTI-FAMILY RESIDENTIAL

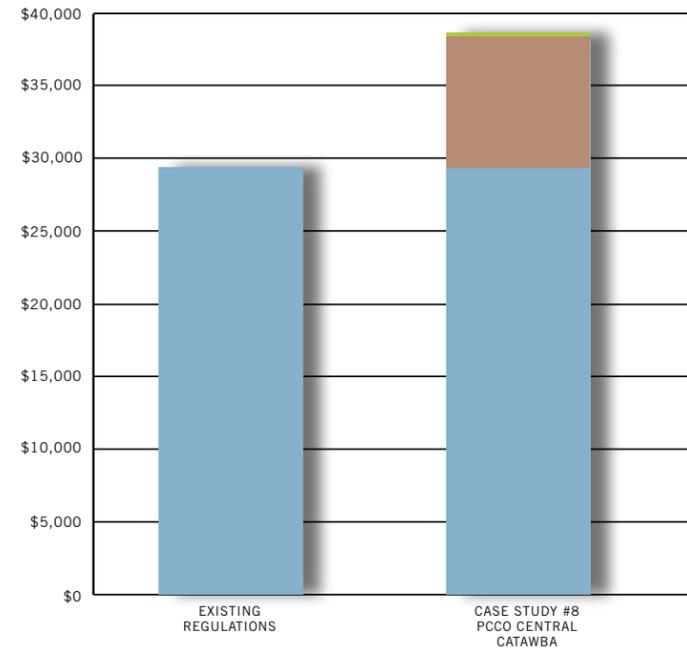
TOTAL ACREAGE: 6.16 ACRES

TOTAL DEVELOPMENT VALUE: APPROXIMATELY \$15 MILLION

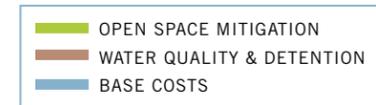
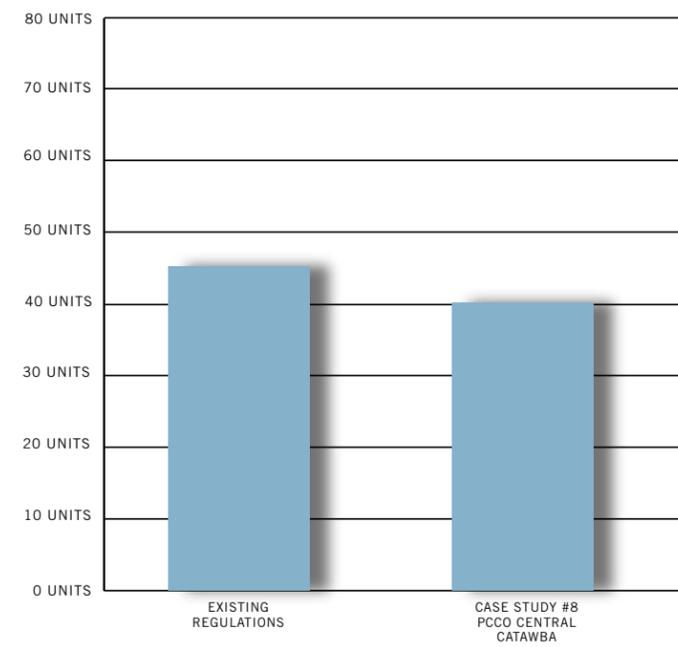
#### MULTI-FAMILY INFRASTRUCTURE COST



#### MULTI-FAMILY COST PER UNIT



#### MULTI-FAMILY UNITS



CUMULATIVE LEVEL OF PROTECTION →

CUMULATIVE LEVEL OF PROTECTION →

CUMULATIVE LEVEL OF PROTECTION →

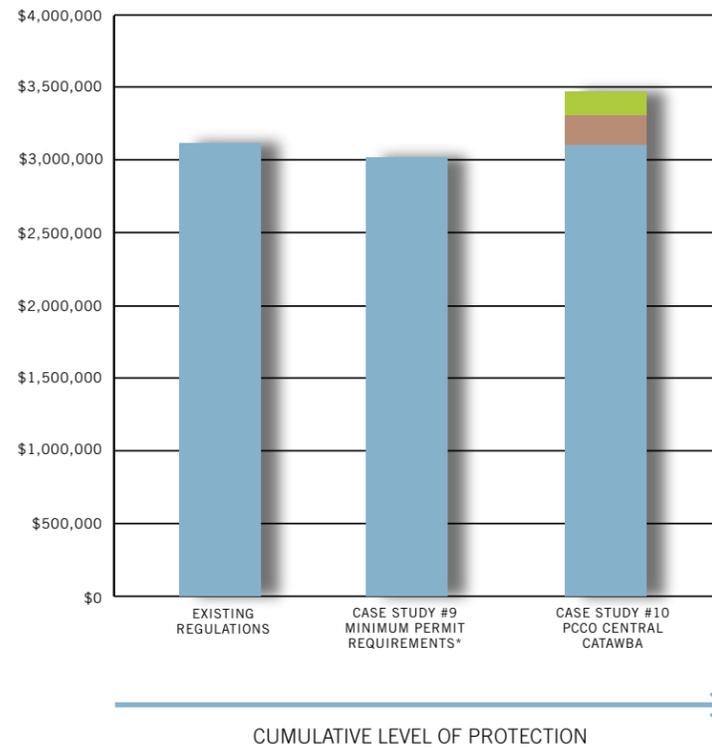
- The Multi-Family Residential case study is not affected by the requirements of the USDG as there are no public roadways proposed.
- The Multi-Family Residential case study is affected by the draft PCCO because storm water measures were introduced. Space needed for storm water controls lead to a reduction in developable property and thereby project density (~10%). Undisturbed open space requirements were satisfied using the on-site mitigation option.
- The projected value of this development is approximately \$15 million. Costs increased \$240,000 or 1.6% to meet the requirements of the draft PCCO.
- Central Catawba provisions closely mimic Minimum Permit Requirements\* and costs are not expected to deviate significantly from the minimum requirements.
- \*See Appendix for Definitions

## COMMERCIAL

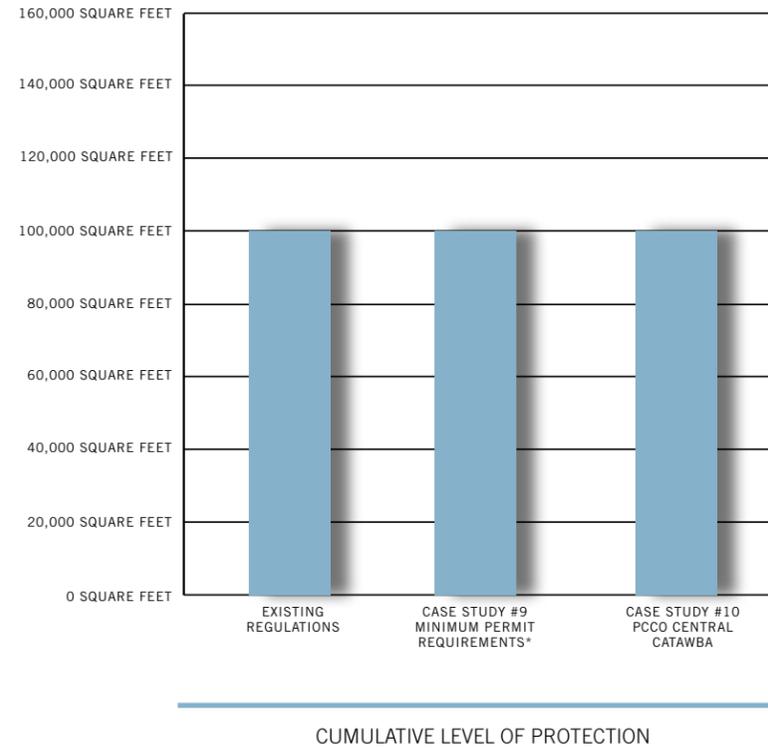
TOTAL ACREAGE: 9.66 ACRES

TOTAL DEVELOPMENT VALUE: APPROXIMATELY \$12.4 MILLION

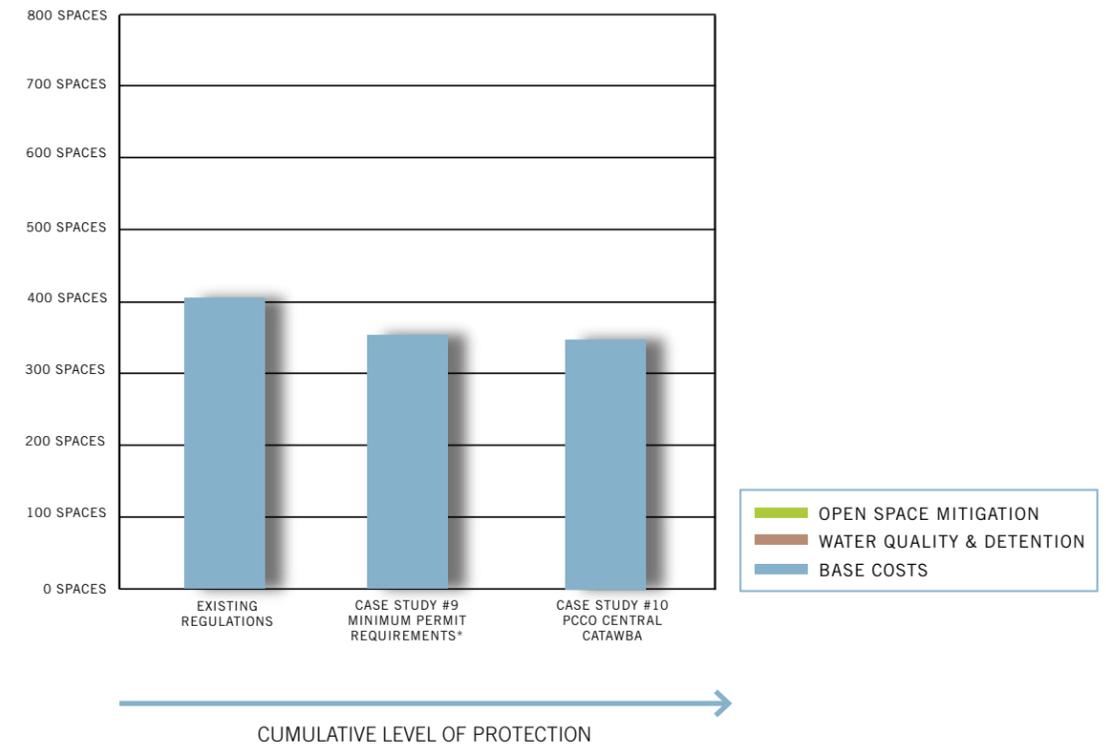
### COMMERCIAL INFRASTRUCTURE COST



### COMMERCIAL GROSS LEASABLE AREA



### PARKING SPACES PROVIDED

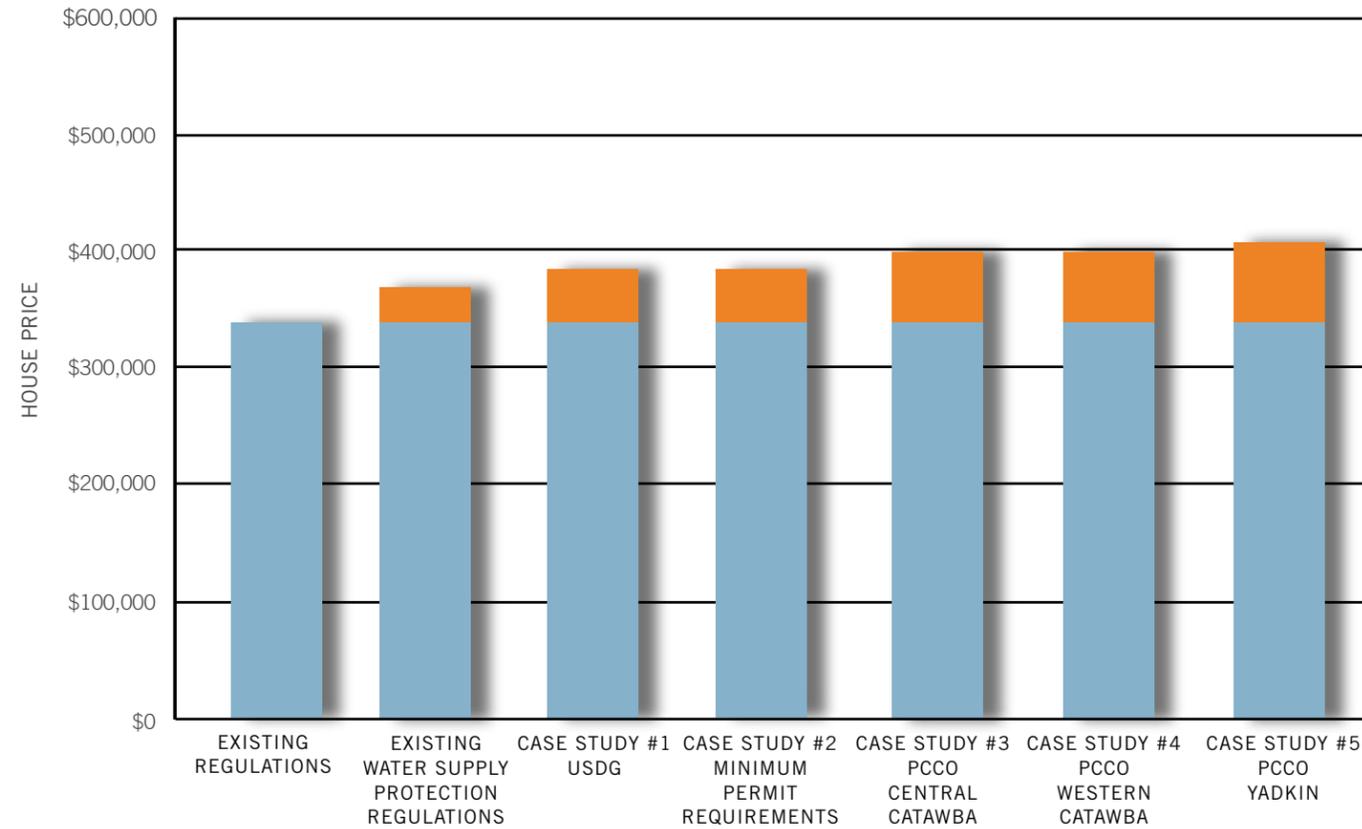


- The Commercial case studies were not affected by the requirements of the USDG as there are no public roadways proposed.
- The Commercial case studies were affected by the Minimum Permit Requirements. However, the costs to meet Minimum Permit Requirements *decreased* approximately \$50,000 by utilizing above-ground storm water treatment controls, although a net loss of 42 parking spaces resulted.
- The Commercial case studies were affected by the draft PCCO because open-space requirements were met using the off-site mitigation option instead of sacrificing developable on-site area. The cost for the off-site mitigation was \$157,000.
- The tax value of this development is approximately \$12.4 million. Costs increased \$350,000 or 2.8% to meet all the requirements of the draft PCCO in the most sensitive watersheds including the off-site open space mitigation payment.
- Although parking spaces were reduced by approximately 10% (4.0 parking spaces per 1,000 square feet of leasable space to 3.6 parking spaces per 1,000 square feet of leasable space), this effect still represents an approvable parking ratio consistent with the proposed GDP-E.
- \*See Appendix for Definitions

SINGLE FAMILY  
RESIDENTIAL  
PROFORMA ANALYSIS

- In an effort to define how the costs of more protective regulations could be absorbed, a proforma analysis was conducted to serve as a model for the projected cash flows during the single-family project development.
- The analyses assumed boundary conditions of 1) the Home Buyer absorbs the changing costs exclusively and 2) the land seller absorbs the changing costs exclusively.
- Results of the proforma analysis indicate if the single family home buyer absorbed all of the cost of more protective regulations it could increase the purchase price of the home by 2 to 5%, depending on the case study. This assumes a 20% profit margin on the increased lot cost to the home builder due to increased site preparation costs with all other costs remaining constant.
- If the property seller absorbed all the costs of more protective regulations it could devalue the property by 19 to 40%, depending upon the case study.
- The projected percentage increases are not meant to be combined but rather to define boundary conditions if either the home buyer or land seller were to exclusively absorb the changing costs. However, costs can be absorbed exclusively or in combination by the home buyer, the land seller, land developer or home builder. The exact distribution of absorption will only be dictated by market requirements and changes due to the adoption of more protective regulations.
- See proforma analysis in Appendix for additional information.

**ANALYSIS 1 INCREASED COST TO HOME BUYER 5X MULTIPLIER**  
(DEVELOPMENT COST PER CITY OF CHARLOTTE ESTIMATE)



PLAN	HOUSE PRICE	HOUSE PRICE INCREASE	% INCREASE
EXISTING REGULATIONS	\$338,200		0%
EXISTING WATER SUPPLY PROTECTION REGULATIONS	\$366,900	\$28,700	9%
CASE STUDY 1-USDG	\$385,000	\$46,800	14%
CASE STUDY 2-MIN PERMIT REQUIREMENTS	\$385,000	\$46,800	14%
CASE STUDY 3-PCCO, CENTRAL CATAWBA	\$397,700	\$59,500	18%
CASE STUDY 4-PCCO, WESTERN CATAWBA	\$397,700	\$59,500	18%
CASE STUDY 5-PCCO, YADKIN	\$409,000	\$70,800	21%

In the Increased Cost to Home Buyer – Five Times Multiplier scenario, the Home Buyer exclusively absorbs the increase infrastructure costs and decreased project yield due to more protective regulations.

While the cost to the Home Buyer goes up, we assumed the following:

- The Land Seller sells the land for the same price for each case study.
- The Developer will make a 20% profit, as the Developer sells subdivided lots to the Home Builder.
- The Home Builder will sell homes for 5 times the cost of the subdivided lot.

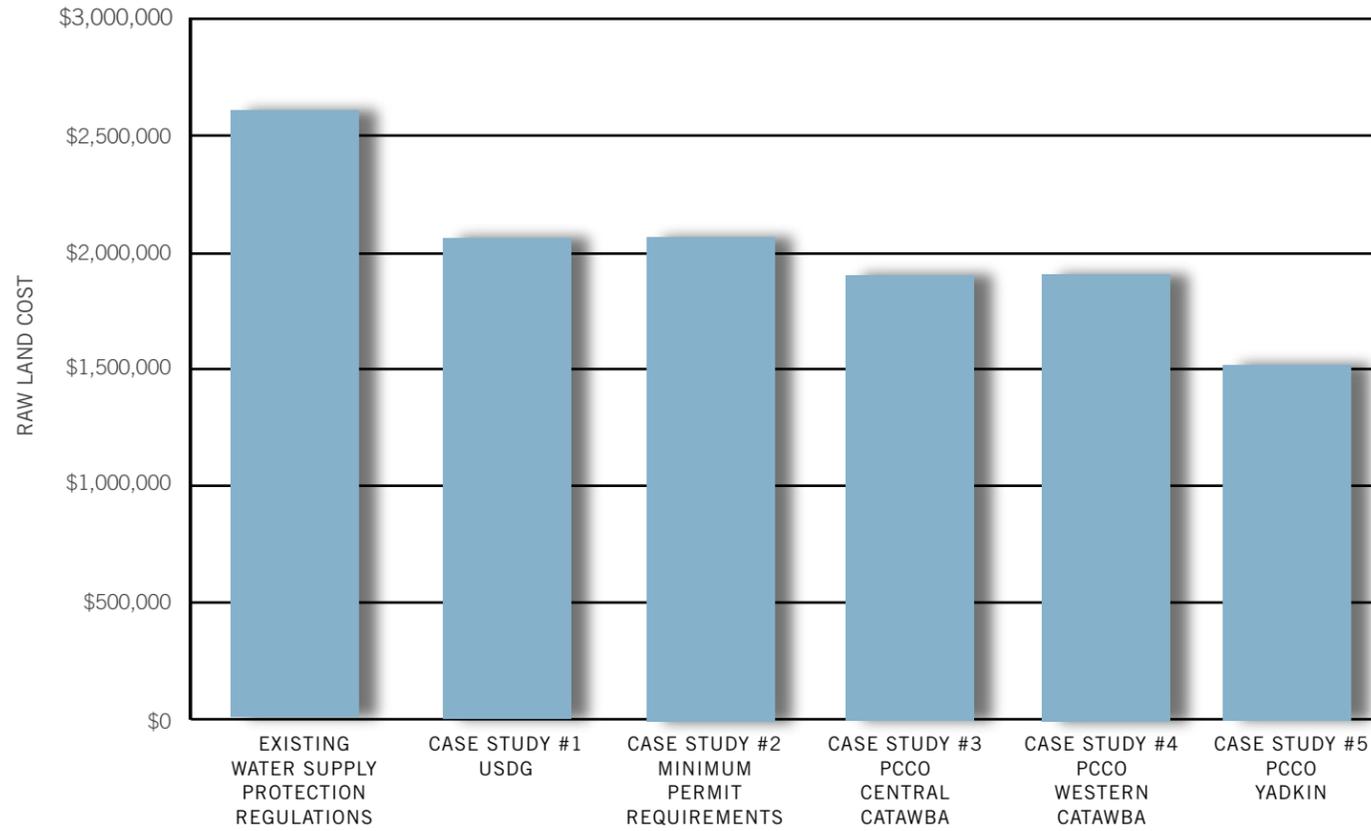
In this scenario, the Home Builder sells a home that is five times the cost of the subdivided lot purchased from the Developer. Therefore, if the Developer were to sell a subdivided lot for \$50,000, the Home Builder would build a home that would sell for \$250,000 in order to make the Home Builder’s desired profit.

These projected home prices are theoretical and do not accurately reflect the sale price of homes in this development.

Possible reasons for discrepancy include the following:

- The current estimated costs are estimates that sometimes do not reflect the actual cost incurred by developers and home builders.
- Construction of the development began in 2002 and labor and material costs have increased substantially in the past 5 years.

**ANALYSIS #2 DECREASED REVENUE FOR THE LAND SELLER**  
(DEVELOPMENT COST PER CITY OF CHARLOTTE ESTIMATE)

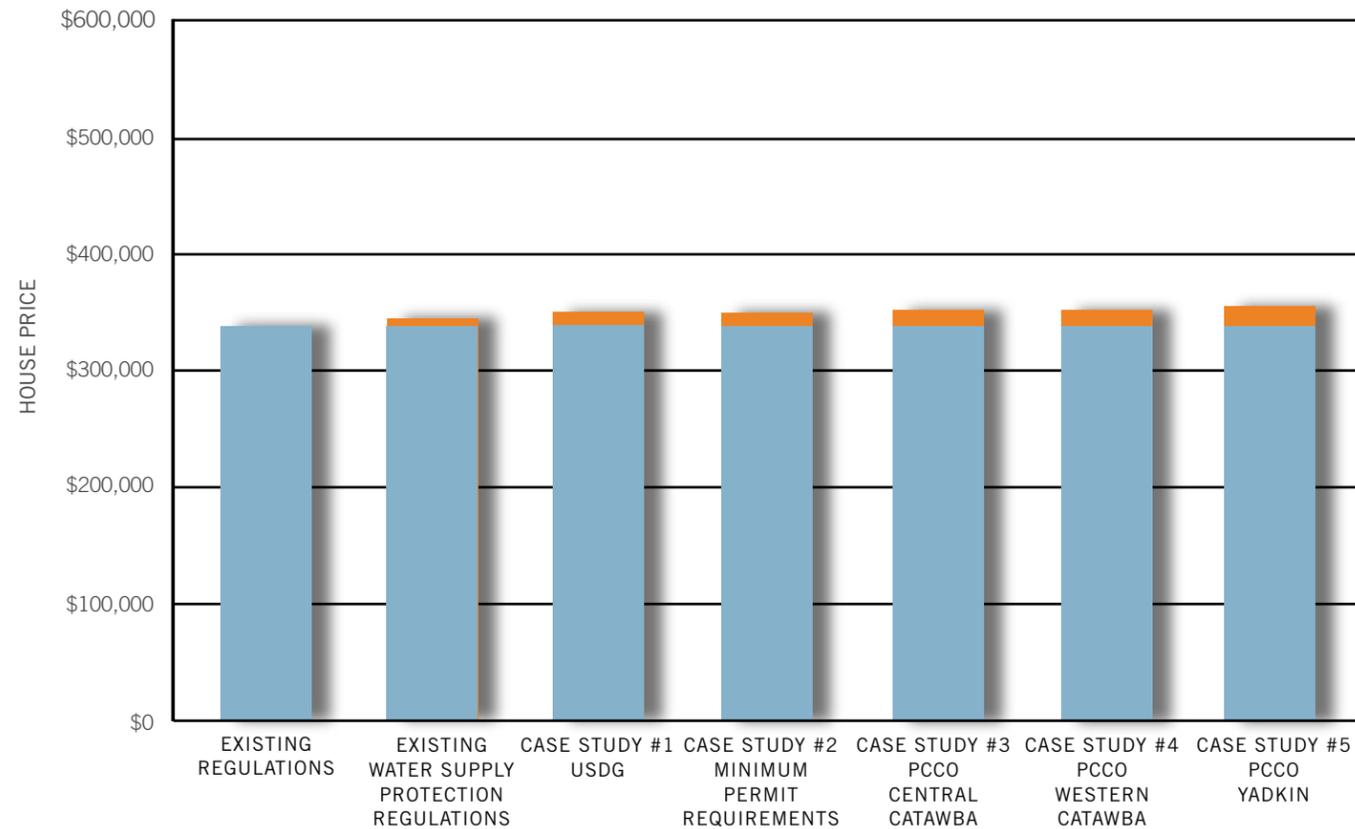


In the Decreased Revenue for the Land Seller scenario, the Land Seller exclusively absorbs the increase infrastructure costs and decreased project yield due to more protective regulations. While selling price of the land decreases, we have assumed the following:

- The Home Buyer purchases homes for the same price for each case study.
- The Developer will make a 20% profit, as the Developer sells subdivided lots to the Home Builder.
- The Home Builder will sell homes for 5 times the cost of the subdivided lot.

PLAN	RAW LAND COST	RAW LAND VALUE DECREASE	% DECREASE
EXISTING WATER SUPPLY PROTECTION REGULATIONS	\$2,600,000		0%
CASE STUDY 1-USDG	\$2,114,500	\$485,500	19%
CASE STUDY 2-MIN PERMIT REQUIREMENTS	\$2,114,500	\$485,500	19%
CASE STUDY 3-PCCO, CENTRAL CATAWBA	\$1,802,700	\$797,300	31%
CASE STUDY 4-PCCO, WESTERN CATAWBA	\$1,802,700	\$797,300	31%
CASE STUDY 5-PCCO, YADKIN	\$1,550,300	\$1,049,700	40%

**ANALYSIS #3 INCREASED COST TO HOME BUYER – CONSTANT HOME PRODUCT**  
(DEVELOPMENT COST PER CITY OF CHARLOTTE ESTIMATE)



In the Increased Cost to Home Buyer – Constant Home Size scenario, the Home Buyer exclusively absorbs the increase infrastructure costs and decreased project yield due to more protective regulations.

While the cost to the Home Buyer goes up, we assumed the following:

- The Land Seller sells the land for the same price for each case study.
- The Developer will make a 20% profit, as the Developer sells subdivided lots to the Home Builder.
- Home Builder product does not change.

In this scenario, the Home Builder builds the same home product even though the cost of the subdivided lot increases with each case study. The Home Builder does not sell a home that is 5 times the cost of the subdivided lot purchased from the Developer. The Home Builder takes the increased cost of the subdivided lot and increases the selling price of the home to realize a 20% return on additional investment.

PLAN	HOUSE PRICE	HOUSE PRICE INCREASE	% INCREASE
EXISTING REGULATIONS	\$338,200		0%
EXISTING WATER SUPPLY PROTECTION REGULATIONS	\$345,400	\$7,200	2%
CASE STUDY 1-USDG	\$349,900	\$11,700	3%
CASE STUDY 2-MIN PERMIT REQUIREMENTS	\$349,900	\$11,700	3%
CASE STUDY 3-PCCO, CENTRAL CATAWBA	\$353,100	\$14,900	4%
CASE STUDY 4-PCCO, WESTERN CATAWBA	\$353,100	\$14,900	4%
CASE STUDY 5-PCCO, YADKIN	\$355,900	\$17,700	5%

The City of Charlotte wishes to evaluate multiple proposed policies/ordinances in an effort to better understand the cumulative economic impact that may occur with their adoption and implementation. The City of Charlotte Cost Analysis project evaluates the construction costs associated with the implementation of: The Environmental Chapter (Phase II) of the General Development Policies (GDP-E), the Urban Street Design Guidelines (USDG), and the Post Construction Controls Ordinance (PCCO). The following describes each of these policies/ordinances which, taken together, are intended to allow Charlotte to continue to grow, while accommodating that growth in a sustainable fashion.

#### GENERAL DEVELOPMENT POLICIES

The *General Development Policies (Phase II)* is a policy document intended to provide a context for future growth that fosters continued economic development while ensuring that the potential negative environmental impacts associated with that growth can be minimized. The principles of the GDP-E include the protection of the natural environment by identifying significant environmentally sensitive areas and providing direction as to their protection or mitigation; facilitating a land use pattern to accommodate growth while respecting the natural environment; promoting environmentally sensitive site designs; and, finally, balancing environmental impacts of land use with other land development considerations, including cost/benefit considerations.

The policies proposed in the GDP-E will be implemented through a wide variety of activities, including making changes to existing regulations, practices and processes, and developing new regulations, practices and processes.

Although the site design evaluation and costs associated with this report will be tied to specific design changes necessitated by the standards set forth in the draft PCCO and USDG, a more qualitative evaluation of the project case studies is provided with this report in relation to the goals of the GDP-E. Specifically, each case study is evaluated to determine if the goals of the GDP-E are effectively met with the implementation of the ordinance/ordinances being incorporated into its site design.

#### POST-CONSTRUCTION CONTROLS ORDINANCE

Under North Carolina's implementation of the Phase I and II storm water regulations for the National Pollution Discharge Elimination System (NPDES), the City of Charlotte

is required to develop and implement a post-construction controls ordinance intended to address the impacts of storm water runoff in areas of new development or redevelopment. In response to this requirement and other storm water quality and quantity challenges, the City of Charlotte partnered with the seven jurisdictions of Mecklenburg County to form a stakeholder committee tasked with developing a new ordinance that addresses storm water runoff by meeting four primary goals:

1. Achieve compliance with the Phase I and Phase II NPDES Storm Water Permit requirements for post-construction pollution control, as applied to the respective jurisdictions, by the EPA.
2. Satisfactorily address the guidelines to mitigate the cumulative and secondary impacts to aquatic and terrestrial wildlife resources and water quality specified by the N.C. Wildlife Resources Commission and the U.S. Fish and Wildlife Service for Goose Creek and the Yadkin River Watershed.
3. Satisfactorily address the causes of impairment identified in the N.C. 2002 Integrated 305(b) and 303(d) Report for surface waters in Mecklenburg County when the potential sources of water quality impairment are identified as urban runoff/storm sewers.
4. Satisfactorily address detention measures for the control of storm water volumes and peaks associated with new construction.

In September 2005, the Post Construction Controls Ordinance Stakeholders Group delivered the draft Post-Construction Controls Ordinance after 18 months of study and deliberation. The ordinance established increased levels of protection from storm water runoff pollution based on the watershed district in which a planned development might be located. Three districts were established in Mecklenburg County: the Central Catawba, the Western Catawba and the Yadkin-Southeast Catawba. Development standards focused on storm water quality treatment for suspended solids and phosphorus pollution generated by the first inch of a rainfall event, storm water volume control for the one-year design storm event, and peak flow detention for the 10-year and 25-year design storm events, if necessary. Stream buffer standards were included, as well as requirements for project open space. Provisions were provided in the ordinance that allowed for reduced standards for projects that were developed to low-density thresholds, as well as projects that were developed within a described transit station area and distressed business district.

The chart on the next page summarizes the development standards required by the PCCO for the applicable watershed districts, as well as the minimum requirements of the regulations of the NPDES as issued by the EPA.

The PCCO references a design manual that is to be used for policy, criteria and information, including technical standards and specifications, for the design, implementation, and performance of structural and non-structural storm water BMPs incorporated to meet the performance standards set forth in the PCCO. The City of Charlotte and Mecklenburg County are currently in the process of developing this manual and have elected not to use the statewide BMP Manual developed by the North Carolina Department of Environment and Natural Resources. The *Charlotte-Mecklenburg BMP Design Manual* intends to provide design methodologies and criteria that are based on local conditions, and are intended to provide a more effective design based on specific watershed conditions present in Charlotte-Mecklenburg. The City of Charlotte Cost Analysis project worked in concert with the BMP Design Manual project to apply the design requirements of the City's refined BMP standards with the projects being analyzed with this study. Therefore, the Cost Analysis results, including the designs and cost estimates, represent the most accurate depiction of future project requirements. The design manual effort is ongoing, and slight refinements to the BMP designs proposed in the Charlotte-Mecklenburg manual may result in slight changes to the results of the Cost Analysis project.

## PCCO DEVELOPMENT STANDARDS

### LOW DENSITY THRESHOLDS / PERFORMANCE STANDARDS

WATERSHED DISTRICT	DENSITY	BMP	BUFFERS
MINIMUM PERMIT REQUIREMENTS*	≤ 24% BUA*	N/A	REQUIRED***
CENTRAL CATAWBA	≤ 24% BUA	VEGETATED CONVEYANCE	REQUIRED**
WESTERN CATAWBA	≤ 12% BUA	VEGETATED CONVEYANCE	REQUIRED**
YADKIN-SOUTHEAST CATAWBA	≤ 10% BUA	VEGETATED CONVEYANCE	REQUIRED**

\* See Appendix for definitions.

\*\* Refer to ordinance for buffer standard requirements

\*\*\* 30-foot no-build zone on all intermittent and perennial streams

### HIGH DENSITY THRESHOLDS / PERFORMANCE STANDARDS

WATERSHED DISTRICT	DENSITY	STORM WATER QUALITY TREATMENT VOLUME	WATER QUALITY TREATMENT	STORM WATER VOLUME CONTROL	STORM WATER PEAK CONTROL	BUFFERS
MINIMUM PERMIT REQUIREMENTS***	> 24% BUA	1" RAINFALL EVENT	85% TSS***	1-YR / 24- HR STORM EVENT*	NOT REQUIRED	REQUIRED
CENTRAL CATAWBA	> 24% BUA	1" RAINFALL EVENT	85% TSS***	1-YR / 24- HR STORM EVENT**	10 YR AND 25 YR, 6 HR STORM	REQUIRED
WESTERN CATAWBA	> 12% BUA	1" RAINFALL EVENT	85% TSS / 70% TP***	1-YR / 24- HR STORM EVENT**	10 YR AND 25 YR, 6 HR STORM	REQUIRED
YADKIN-SOUTHEAST CATAWBA	> 10% BUA	1" RAINFALL EVENT	85% TSS / 70% TP***	1-YR / 24- HR STORM EVENT**	10 YR AND 25 YR, 6 HR STORM	REQUIRED

\* Difference between pre- and post-development run-off volume.

\*\* Entire 1 year volume

\*\*\* See Appendix for definitions.

Notes:

1. Pollutant removal efficiencies shall be obtained via methodologies described in the Design Manual.
2. Runoff volume drawdown shall be a minimum of 24 hours, but no greater than 120 hours.
3. A downstream analysis may be performed as described in the Design Manual to reduce detention requirements.
4. Refer to ordinance for buffer standard requirements.

### OPEN SPACE REQUIREMENTS

PROJECT DENSITY	UNDISTURBED OPEN SPACE REQUIRED
MINIMUM PERMIT REQUIREMENTS*	NOT REQUIRED
< 24% BUA	25% OF PROJECT AREA
> 24% BUA, < 50% BUA	17.5% OF PROJECT AREA
> 50% BUA	10% OF PROJECT AREA

\* See Appendix for definitions.

Notes:

1. Undisturbed open space shall be recorded at the Register of Deeds as "Undisturbed Open Space."
2. Refer to ordinance for mitigation and payment-in-lieu-of options for undisturbed open space requirements.



**URBAN STREET DESIGN GUIDELINES**

Charlotte's ability to accommodate growth, while maintaining its quality of life, requires a concerted effort to enhance the City's approach to providing transportation. The *Urban Street Design Guidelines* (USDG) present a comprehensive approach to designing new and modified streets within Charlotte's sphere of influence. By applying the USDG to streets that will be constructed (or re-constructed) by the City, and constructed through the land development process, Charlotte will have a street network that continues to function well, even as growth continues.

A key implementation component of the *Transportation Action Plan* (adopted in 2006), the USDG are intended to help Charlotte accommodate growth by meeting the following objectives:

1. Support economic development and quality of life, by providing both transportation capacity and building better streets for all users;
2. Provide more and safer transportation choices, by improving network connectivity (providing both capacity and shorter travel routes), and by building streets that are safe and functional for motorists, bicyclists, pedestrians, and transit users; and
3. Better integrate land use and transportation decisions, by building context-based streets that match the surrounding land uses and by building the street network that will accommodate differing levels of land use intensity.

To develop the street network that accomplishes these objectives, the USDG establish five street classifications that reflect and complement a variety of land use and transportation contexts: Main Streets, Avenues, Boulevards, Parkways, and Local Streets. The Local Street category is further divided into street types that support a variety of different local street land use contexts. The USDG street categories range from very auto-oriented, thoroughfare-type streets to local, neighborhood streets, and all include design elements and dimensions intended to achieve the best street for a given land use and transportation context.

Implementing the USDG will, over time, result in a well-connected network of functional, safe, and attractive streets that serve all users and complement the communities and neighborhoods they connect, while also providing the transportation capacity and travel choices necessary to sustain long-term growth and development.



SITE  
SELECTION/  
CASE STUDIES

2

TIER MATRIX

**BACKGROUND**

In order to comply with Clean Water Act (NPDES Phase I and II) regulations, the City of Charlotte and Mecklenburg County jointly held stakeholder group meetings starting in April 2004. As part of the stakeholder group process, rough cost estimates were prepared and presented for several different draft sets of proposed regulations. These costs represented “rule of thumb” construction costs required to meet the ordinance provisions, as they were based on hypothetical sites with no site plan, grading and drainage plan, or quantity takeoffs for cost estimation. The purpose of this Cost Analysis project is to better define the potential cost impacts to new development of varying land use and location within the City for different development standards based on the sensitivity of the receiving watersheds. Although the cost estimates developed through this project are site specific, they represent much more detailed estimates than have been presented thus far. The proposed regulations analyzed with this project are the Draft Post Construction Controls Ordinance and Urban Street Design Guidelines. Comments regarding whether the project meets the intent of the Environmental Chapter of the City’s General Development Policies are also provided.

**SELECTION PARAMETERS**

The engineering standards and ordinance requirements vary with the percent imperviousness of the site, so a range of land-use types corresponding to differing levels of percent imperviousness were chosen. With this framework in place, four different land use types were chosen to take forward to pricing level design documents in order to estimate costs. The first land-use type selected was a single-family subdivision, followed by multi-family, commercial and transit-oriented use. These land-use types represent a wide cross section of the developments seen within the City and correspond to increasing levels of imperviousness, which, as previously stated, influence the storm water controls needed to meet ordinance requirements. Again, the analysis and results are specific to these sites.

Once the land use types were identified, the following considerations guided the selection of the specific sites:

- A. Size of site: In an effort to limit design schedule and budget, where projects were similar in nature, the smaller of the sites was chosen.
- B. Age of site plan: Newer sites were chosen over older developments in order to address two concerns: 1) newer developments more closely resemble the housing and commercial products being built today, and 2) older projects may have been designed under older ordinances and development standards.

- C. Ability to acquire existing data (i.e., development plans/drawings): To limit design budget and schedule, sites for which the consultant could access existing data were chosen.
- D. Existing conditions: Sites with more typical environmental conditions were chosen over those that had very unique environmental conditions.
- E. Location: Sites within Charlotte’s land use jurisdiction were chosen to allow direct comparison to existing and proposed regulations and policies.

**PROJECT SELECTION**

Once the four land uses were chosen, the team considered sites that could be used for Cost Analysis case studies. Several sites within each land use type were considered and are summarized below:

PROJECT CONSIDERED	PROJECT DISCUSSION
<b>SINGLE FAMILY</b>	
<ul style="list-style-type: none"> <li>• New SF Development in 1st Ward</li> </ul>	Small single-family infill project built on existing street; not a typical development product
<ul style="list-style-type: none"> <li>• The Village at Buckland</li> </ul>	Typical single-family product that is representative of similar projects in and around Charlotte. 50-acre typical mass-graded site. Relatively new subdivision still under construction. Significant street network to evaluate effects of USDG. Environmentally sensitive areas to be preserved under GDP-E.
<b>URBAN INFILL (TRANSIT ORIENTED DEVELOPMENT)</b>	
<ul style="list-style-type: none"> <li>• 101 Tremont</li> </ul>	Located in transit station area. Represents redevelopment of a site with greater than 90% impervious.
<ul style="list-style-type: none"> <li>• Alpha Mill</li> </ul>	Involved retrofit of existing buildings, which created site constraints not typical of current development patterns.
<b>MULTI-FAMILY</b>	
<ul style="list-style-type: none"> <li>• Huntersville Townhomes</li> </ul>	Project outside of City jurisdiction, therefore was not approved under current City regulations
<ul style="list-style-type: none"> <li>• South Oak Crossing</li> </ul>	Large site with significant wetlands ; extent of environmental challenges not typical
<ul style="list-style-type: none"> <li>• The Landing on Mountain Island Lake</li> </ul>	Large project built under development standards from late 1980s; conditional zoning from 1988
<ul style="list-style-type: none"> <li>• The Village at Avonlea</li> </ul>	Good project candidate, but not chosen due to size (20+ acres) and imperviousness that closely matched Village at Buckland.
<ul style="list-style-type: none"> <li>• Elm Lane Townhouse (f/k/a Dalston Hill)</li> </ul>	Good project candidate, eventually chosen due to manageable size (~ 7 acres), typical product, and relatively new development.
<b>COMMERCIAL/INDUSTRIAL</b>	
<ul style="list-style-type: none"> <li>• Westinghouse Boulevard Office/Warehouse</li> </ul>	Small project, atypical due to coordination with Westinghouse Boulevard improvements; project built in mid 1990s. Representative of small percentage of development occurring in Charlotte.
<ul style="list-style-type: none"> <li>• Northlake Commons</li> </ul>	Good project candidate, but included several outparcels that were not built out as a part of the initial development. Would not conform to General Development Policies adopted in 2003.
<ul style="list-style-type: none"> <li>• Colony Place Shopping Center</li> </ul>	Good project candidate, eventually selected due to manageable project size (~10 acres) and representation of current development patterns.

**CASE STUDY SELECTION**

Once the projects were selected to represent each of the four land use types, the team considered which sets of ordinance criteria to apply to each site. The intent of the exercise was to match project sites to watershed districts where projects are more likely to be developed. There also was a desire to obtain a range/cross-section of project types in order to get a range of costs associated with various permutations of the proposed ordinances. The following matrix was developed to show how projects were matched to watershed districts.

TIERS	SITES			
	SINGLE FAMILY RESIDENTIAL	URBAN INFILL (TRANSIT)	MULTI-FAMILY RESIDENTIAL	COMMERCIAL
EXISTING REGULATIONS	X	DONE	DONE	DONE
EXISTING WATER SUPPLY REGULATIONS	DONE			
USDG ONLY	X			
MINIMUM PERMIT REQUIREMENTS	X	*		X
PCCO TRANSIT PROVISIONS		X		
FULL PCCO-CENTRAL	X	X	X	X
FULL PCCO-WESTERN	X			
FULL PCCO-YADKIN	X			

NOTE: All sites assume that USDG and GDP-E requirements will be met.

\*MIN PERMIT REQUIREMENTS have no additional controls if site impervious is not increased for redeveloping sites

**HOW GDP-E IS ADDRESSED?**

For each case study, planning staff reviewed the site plans and provided comments as to whether or not the site design met the intent of the draft GDP-E. The following five questions were used to guide the staff review to ensure that the draft policies, relevant at a site plan level, were addressed.

Does the site design:

1. Protect or mitigate environmentally sensitive areas?
2. Facilitate alternative modes of transportation and reduce ground level temperatures?
3. Minimize impacts to natural features?
4. Reduce the amount and improve the quality of storm water run-off?
5. Use water efficiently?

A summary of case study evaluations are provided with each.



# 3

## CASE STUDIES

- SINGLE FAMILY RESIDENTIAL
- URBAN INFILL
- MULTI-FAMILY RESIDENTIAL
- COMMERCIAL



CASE STUDIES

SINGLE FAMILY RESIDENTIAL

OVERVIEW

FACT SHEET

COST SUMMARY ESTIMATE

EXISTING CONDITIONS

EXISTING REGULATIONS

EXISTING WATER SUPPLY PROTECTION REGULATIONS

CASE STUDY #1 USDG

CASE STUDY #2 MINIMUM PERMIT REQUIREMENTS

CASE STUDY #3 PCCO-CENTRAL CATAWBA

CASE STUDY #4 PCCO-WESTERN CATAWBA

CASE STUDY #5 PCCO-YADKIN



The project example for the single-family residential program is an approximately 50-acre site located within the Lower Lake Wylie watershed overlay district. It is a wooded site with small pockets of isolated wetlands along a jurisdictional drainage feature along one boundary, and floodway limits and additional wetlands along another. The approved project is part of a larger re-zoned master planned community with shared design elements, but was analyzed as a stand alone parcel for the purposes of this study. The project site was rezoned to an MX-1 zoning from an R-3 zoning classification. The program for the approved project is a slab-on-grade, single family residential product that requires mass grading of the site. For comparative purposes, this program will be continued with each design analysis. The land cost for this site was approximately \$2.6 million.

The single family project example was designed and approved according to the existing regulations of the Lower Lake Wylie watershed overlay district, referred to as Existing Water Supply Protection Regulations plan. Currently, the watershed overlay districts require post construction stormwater controls similar to the Minimum Permit Requirements. Since a majority of land within the City of Charlotte is outside watershed overlay districts, the approved single family project example was redesigned using existing regulations outside watershed overlay districts and is referred to as the Existing Regulations plan. Redesigning the approved Existing Regulations - Water Supply Protection plan using Existing Regulations allows for comparison of the PCCO against the standard Existing Regulations that do not require any post construction stormwater controls.

After establishing the Existing Regulations base for comparison, the single family project example was redesigned for each design tier being analyzed with the Cost Analysis project, while keeping most of the approved development assumptions constant. Namely the approved plan for the single-family development was redesigned to incorporate the USDG, Minimum Permit Requirements and the Central Catawba, Western Catawba and the Yadkin-Southeast Catawba Districts of the PCCO. The elements incorporated into the project as part of the USDG were brought forth with subsequent phases of design analyses. Cost estimates are carried forward with each design tier analyzed.

In summary, the Existing Regulations plan is a redesign of the approved and constructed Existing Water Supply Protection Regulations plan. The Existing Water Supply Protection Regulations plan was developed to meet the current requirements of the subdivision ordinance, the detention ordinance and the requirements of the Lower Lake Wylie watershed overlay district. The project includes wet detention ponds, designed to NCDENR standards, as well as provide storm water detention for peak flows associated with the 2-year and 10-year design storm events. Open space is provided to current standards and buffers, and project edges are provided to meet S.W.I.M., watershed and other requirements. With the USDG analysis, the street pattern was changed to meet block size and connectivity requirements. No additional storm water restrictions were imposed. Once the USDG were addressed, additional storm water controls were incorporated with each subsequent design analysis, ranging from minimum permit requirements to the more protective controls associated with the Yadkin-Southeast Catawba section of the PCCO. Each analysis carried with it the appropriate controls, including storm water detention and runoff volume controls, water quality controls, including 85% TSS and 70% TP removal efficiency criteria, as well as corresponding buffers and undisturbed open space requirements. Infrastructure costs associated with these design tiers ranged from \$6.46 million for the current Existing Regulations plan to \$6.75 million for the USDG design tier.

Wet detention ponds were incorporated with each design as this BMP could effectively meet TSS, TP, detention and volume control requirements. Changes to the street and lot layout were necessary to capture increasing open space and buffer thresholds. As much as possible, open space was mitigated for on-site to maximize lot yield, including platting, mitigated undisturbed open space at rear yards on private lots. Site grading remained fairly consistent, and actually tended to decrease due to the requirement of undisturbed open space.

Staff reviewed the project development in relation to the draft Environmental Chapter of the City of Charlotte's General Development Policies (GDP-E). The application of the USDG and the combination of undisturbed open space, mitigated open space and water quality protection provided by the PCCO would serve to meet the intent of the GDP-E.

## DESIGN CRITERIA

ELEMENTS	EXISTING REGULATIONS	EXISTING WATER SUPPLY PROTECTION REGULATIONS	USDG	MIN PERMIT REQUIREMENTS*	PCCO - CENTRAL	PCCO - WESTERN	PCCO - YADKIN
BLOCK FACE LENGTH (PREFERRED)	(AS APPROVED)	(AS APPROVED)	500'-600'	500'-600'	500'-600'	500'-600'	500'-600'
SINGLE BLOCK FACE LENGTH (MAX)	(AS APPROVED)	(AS APPROVED)	800'	800'	800'	800'	800'
MAXIMUM BLOCK PERIMETER	N/A	N/A	2,800'	2,800'	2,800'	2,800'	2,800'
EXTERNAL CONNECTIONS	(AS APPROVED)	(AS APPROVED)	=BLOCK LENGTH	=BLOCK LENGTH	=BLOCK LENGTH	=BLOCK LENGTH	=BLOCK LENGTH
CREEK CROSSINGS	(AS APPROVED)	(AS APPROVED)	EVERY 1,300' (APPROX)	EVERY 1,300' (APPROX)	EVERY 1,300' (APPROX)	EVERY 1,300' (APPROX)	EVERY 1,300' (APPROX)
UNDISTURBED OPEN SPACE*	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	17.5%	17.5%	17.5%
TREE SAVE*	10%	10%	10%	10%	10%	10%	10%
BUFFERS	SWIM	SWIM / WATERSHED	SWIM / WATERSHED	SWIM / WATERSHED	PCCO	PCCO	PCCO
85% TSS* REMOVAL		X	X	X	X	X	X
70% TP* REMOVAL						X	X
DETENTION		X	X	X	X	X	X
VOLUME CONTROL				X	X	X	X

\* See Appendix for definitions.

**DEVELOPMENT SUMMARY**

ELEMENTS	EXISTING REGULATIONS	EXISTING WATER SUPPLY PROTECTION REGULATIONS	USDG	MIN PERMIT REQUIREMENTS**	PCCO - CENTRAL	PCCO - WESTERN	PCCO - YADKIN
ZONING	MX-1	MX-1	MX-1	MX-1	MX-1	MX-1	MX-1
SITE ACREAGE	51.9	51.9	51.9	51.9	51.9	51.9	51.9
55' Lots	100	107	105	105	100	100	94
68' Lots	86	64	63	63	62	62	62
LOTS (#)	186	171	168	168	162	162	156
DWELLING UNIT PER ACRE (DUA)**	3.58 DUA	3.29 DUA	3.24 DUA	3.24 DUA	3.10 DUA	3.10 DUA	3.00 DUA
PUBLIC STREETS (LINEAR FEET)	8,259.7 LF	7,247.3 LF	7,921.0 LF	7,921.0 LF	7,780.3 LF	7,780.3 LF	7,780.3 LF
% IMPERVIOUS	48%	44%	44%	44%	44%	44%	43%
OPEN SPACE REQUIRED**	5.2 AC (10%)	5.2 AC (10%)	5.2 AC (10%)	5.2 AC (10%)	5.2 AC (10%)	5.2 AC (10%)	5.2 AC (10%)
OPEN SPACE PROVIDED	7.9 AC (15.2%)	9.9 AC (19%)	10.5 AC (20.3%)	10.5 AC (20.3%)	13.1 AC (25.2%)	13.1 AC (25.2%)	13.9 AC (26.8%)
TREE SAVE AREA REQUIRED**	5.2 AC (10%)	5.2 AC (10%)	5.2 AC (10%)	5.2 AC (10%)	5.2 AC (10%)	5.2 AC (10%)	5.2 AC (10%)
TREE SAVE AREA PROVIDED	6.73 AC (12.9%)	6 AC (11.5%)	5.2 AC (10%)	5.2 AC (10%)	5.5 AC (10.6%)	5.5 AC (10.6%)	6.4 AC (12.3%)
UNDISTURBED OPEN SPACE REQUIRED**	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	9.08 AC (17.5%)	9.08 AC (17.5%)	9.08 AC (17.5%)
UNDISTURBED OPEN SPACE PROVIDED	5.82 AC (11.2%)	5 AC (9.6%)	4.75 AC (9.1%)	4.75 AC (9.1%)	4.8 AC (9.5%)	4.8 AC (9.5%)	5.78 AC (11.1%)
MITIGATED UNDISTURBED OPEN SPACE	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED	6.35 AC	6.35 AC	4.3 AC
BMP** WET POND	NOT REQUIRED	40,500 SF	40,500 SF	40,500 SF	79,100 SF	79,100 SF	79,300 SF
OFF-SITE IMPROVEMENTS	N/A	N/A	N/A	N/A	N/A	N/A	N/A

\* All site design elements are applied as required to meet conditions of draft ordinances/policies based on specific conditions of site and in some cases, the original development plan. Some elements and results would change with changing site conditions or slight variations in the development plan. Items specific to the approved plan were, where possible, held constant or varied only slightly to meet draft policies.

\*\* See Appendix for definitions.



**COST ESTIMATE SUMMARY**

ELEMENTS	EXISTING REGULATIONS	EXISTING WATER SUPPLY PROTECTION REGULATIONS	USDG	MIN PERMIT REQUIREMENTS	PCCO - CENTRAL	PCCO - WESTERN	PCCO - YADKIN
	MX-1	MX-1	MX-1	MX-1	MX-1	MX-1	MX-1
LOT YIELD	186	171	168	168	162	162	156
ALLOWANCES	\$37,800	\$37,800	\$37,800	\$37,800.00	\$37,800.00	\$37,800.00	\$37,800.00
SITE GRADING	\$1,523,400	\$1,591,100	\$1,599,800	\$1,599,800	\$1,525,100	\$1,525,100	\$1,523,500
PAVING	\$1,251,400	\$1,089,300	\$1,347,600	\$1,347,600	\$1,323,700	\$1,323,700	\$1,323,700
STORM DRAINAGE	\$1,380,500	\$1,485,100	\$1,540,100	\$1,540,100	\$1,552,700	\$1,552,700	\$1,564,600
WET DETENTION PONDS	N/R	\$100,900	\$120,800	\$120,800	\$108,300	\$108,300	\$101,400
PRE DEVELOPMENT EROSION CONTROL	\$109,800	\$109,800	\$109,800	\$109,800	\$109,800	\$109,800	\$109,800
POST DEVELOPMENT EROSION CONTROL	\$139,600	\$139,600	\$139,600	\$139,600	\$139,600	\$139,600	\$139,600
LANDSCAPING AT ENTRY	\$5,600	\$5,600	\$5,600	\$5,600	\$5,600	\$5,600	\$5,600
WATER & SANITARY SEWER	\$2,015,900	\$1,853,400	\$1,820,900	\$1,820,900	\$1,745,000	\$1,745,000	\$1,680,000
OPEN SPACE MITIGATION	N/R	N/R	N/R	N/R	\$116,100	\$116,100	\$78,600
LITTORAL SHELF PLANTING	N/R	\$26,400	\$26,400	\$26,400	\$44,500	\$44,500	\$43,600
<b>TOTAL</b>	<b>\$6,464,100</b>	<b>\$6,439,100</b>	<b>\$6,748,400</b>	<b>\$6,748,400</b>	<b>\$6,708,100</b>	<b>\$6,708,100</b>	<b>\$6,608,100</b>

\* All site design elements are applied as required to meet conditions of draft ordinances/policies based on specific conditions of site and in some cases, the original development plan. Some elements and results would change with changing site conditions or slight variations in the development plan. Items specific to the approved plan were, where possible, held constant or varied only slightly to meet draft policies.

\*\* See Appendix for definitions.

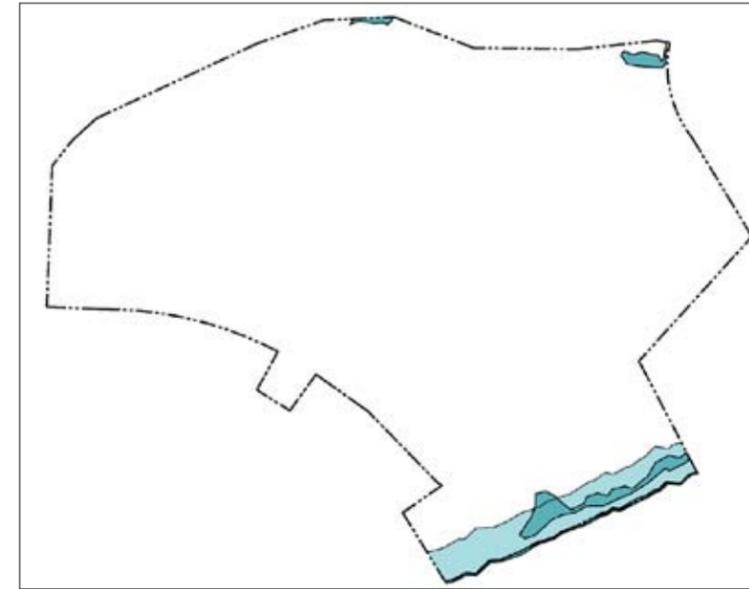
\*\*\* Wet detention pond cost does not include grading



# 1

## CONTEXT MAP

The site is one phase of a single family master plan development. The site is located near Lake Wylie, but will be studied in each tier of watershed stipulation. The site was studied as a stand alone, infill development for the purposes of this study.



# 3

## BUFFERS AND WETLANDS

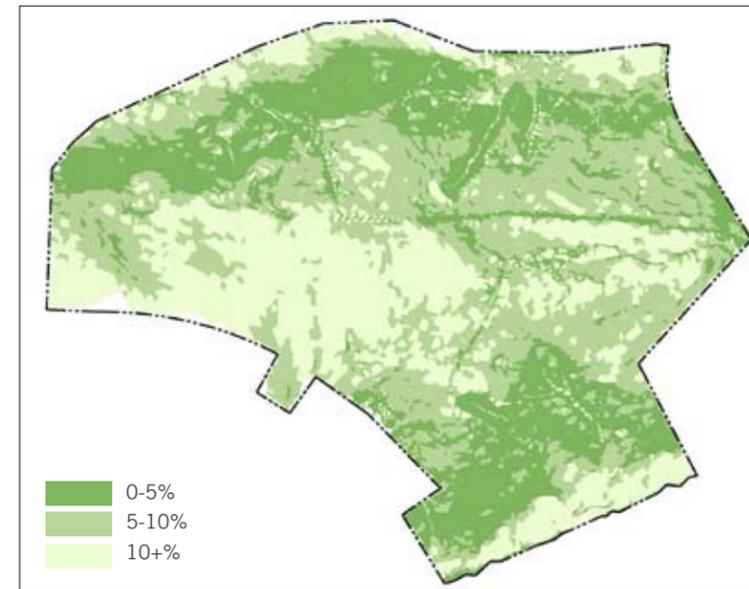
A jurisdictional stream runs along the east of the property with pocket wetlands. An intermittent stream borders the west portion of the site. The intermittent stream did not have a buffer requirement under existing zoning.



# 2

## EXISTING TREES

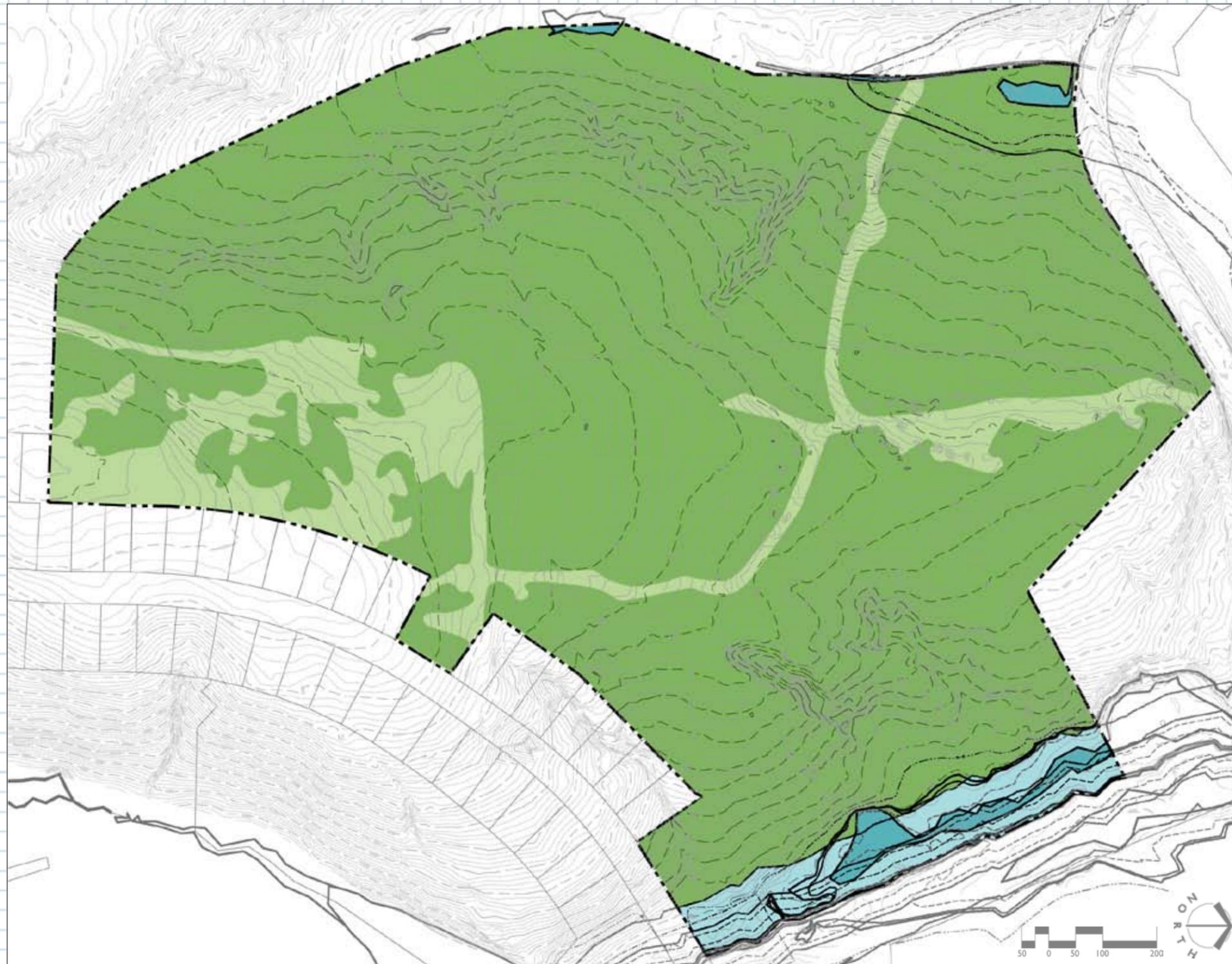
Over 90% of the existing site was covered with trees.



# 4

## SLOPE ANALYSIS

32 % of the existing topography has a slope of 10% or greater. 38% of the site has slopes within the 5-10% and 30% of the site has slopes less than 5%. A portion of the 0-5% slopes are located in the floodplain and wetland area.



### DEVELOPMENT SUMMARY

- ZONING: MX-1
- SITE ACREAGE: 51.9
- 55' LOTS: 0
- 68' LOTS: 0
- TOTAL LOTS: 0
- DUA: 0
- PUBLIC STREETS (LF): 0
- PERCENT IMPERVIOUS: 0
- OPEN SPACE REQUIRED (AC): 0
- OPEN SPACE PROVIDED (AC): 0
- TREE SAVE REQUIRED (AC): 0
- TREE SAVE PROVIDED (AC): 0
- UNDISTURBED OPEN SPACE REQUIRED (AC): 0
- UNDISTURBED OPEN SPACE PROVIDED (AC): 0
- MITIGATED UNDISTURBED OPEN SPACE (AC): 0
- BMP - WET PONDS: 0
- OFF-SITE IMPROVEMENTS: 0

### COST ESTIMATE SUMMARY

- N/A

### NOTES

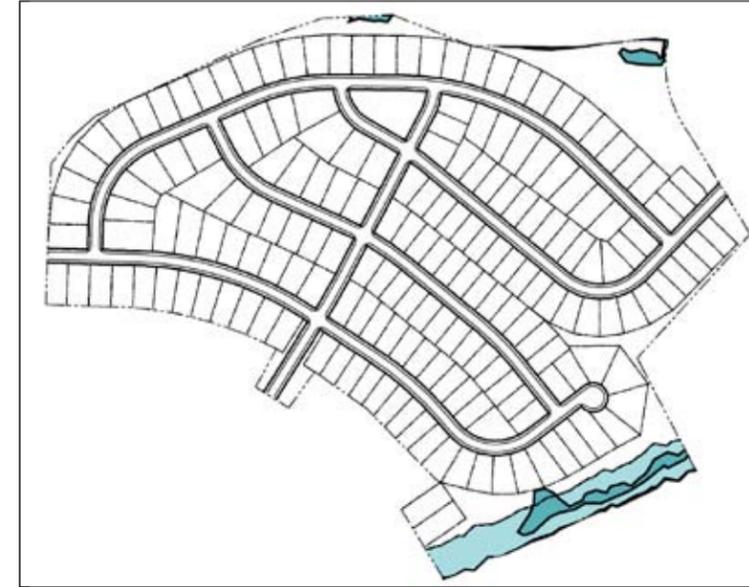
This parcel is part of a master planned community of a larger assembled tract of land. Many development requirements were met as part of the master planned project, but, for the purposes of this analysis, this tract was analyzed as a stand-alone site.



# 1

## UNDISTURBED OPEN SPACE

Undisturbed open space is not required under existing zoning. The Existing Regulations plan is required to provide 10% open space, but the open space does not need to be undisturbed. The Existing Regulations plan provided 5.8 acres (11.2%) of undisturbed open space.



# 3

## BUFFERS AND WETLANDS

A 100-foot undisturbed buffer is required on the stream on the eastern property boundary. No buffer is required on the intermittent stream on the western property boundary. Wetland buffers were provided per 404 permit standard conditions.



# 2

## TREE SAVE

Existing zoning is required to provide 10% tree save. The Existing Regulations plan provided slightly more than the required 10% tree save.



# 4

## LOT MIX

Existing Regulations plan consists of two lot sizes: 68' lots and 55' lots.



### DEVELOPMENT SUMMARY

- ❑ ZONING: MX-1
- ❑ SITE ACREAGE: 51.9
- ❑ 55' LOTS: 100
- ❑ 68' LOTS: 86
- ❑ TOTAL LOTS: 186
- ❑ DUA\*: 3.58
- ❑ PUBLIC STREETS (LF): 8,259.7 LF
- ❑ PERCENT IMPERVIOUS: 48%
- ❑ OPEN SPACE REQUIRED\* (AC): 5.2 AC (10%)
- ❑ OPEN SPACE PROVIDED (AC): 7.9 AC (15.2%)
- ❑ TREE SAVE REQUIRED\* (AC): 5.2 AC (10%)
- ❑ TREE SAVE PROVIDED (AC): 6.73 AC (12.9%)
- ❑ UNDISTURBED OPEN SPACE REQUIRED (AC): N/R
- ❑ UNDISTURBED OPEN SPACE PROVIDED\* (AC): 5.82 AC (11.2%)
- ❑ MITIGATED UNDISTURBED OPEN SPACE (AC): N/R
- ❑ BMP - WET PONDS: N/R
- ❑ OFF-SITE IMPROVEMENTS: N/A

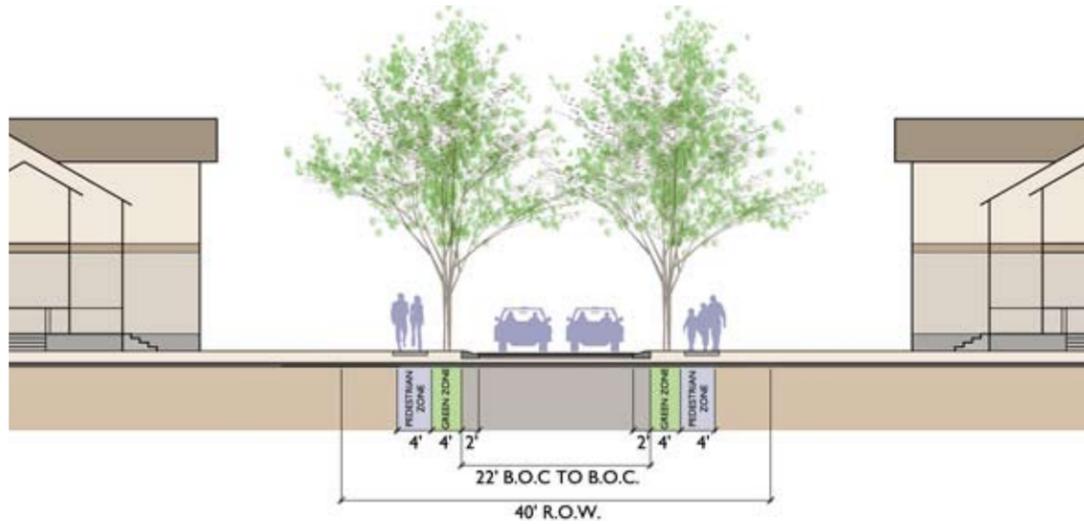
### COST ESTIMATE SUMMARY

- ❑ ALLOWANCES: \$37,800
- ❑ SITE GRADING: \$1,523,400
- ❑ PAVING: \$1,251,400
- ❑ STORM DRAINAGE: \$1,380,500
- ❑ WET DETENTION PONDS: N/R
- ❑ PRE DEVELOPMENT EROSION CONTROL: \$109,800
- ❑ POST DEVELOPMENT EROSION CONTROL: \$139,600
- ❑ LANDSCAPING AT ENTRY: \$5,600
- ❑ WATER & SANITARY SEWER: \$2,015,900
- ❑ OPEN SPACE MITIGATION: N/R
- ❑ LITTORAL SHELF PLANTING: N/R
- ❑ **TOTAL: \$6,464,100**

### NOTES

The Existing Regulations plan provided 186 lots at a DUA of 3.58. The Existing Regulations plan was designed maximizing developable area. Open space provided was a product of tree save and buffer requirements.

\* See Appendix for definitions.

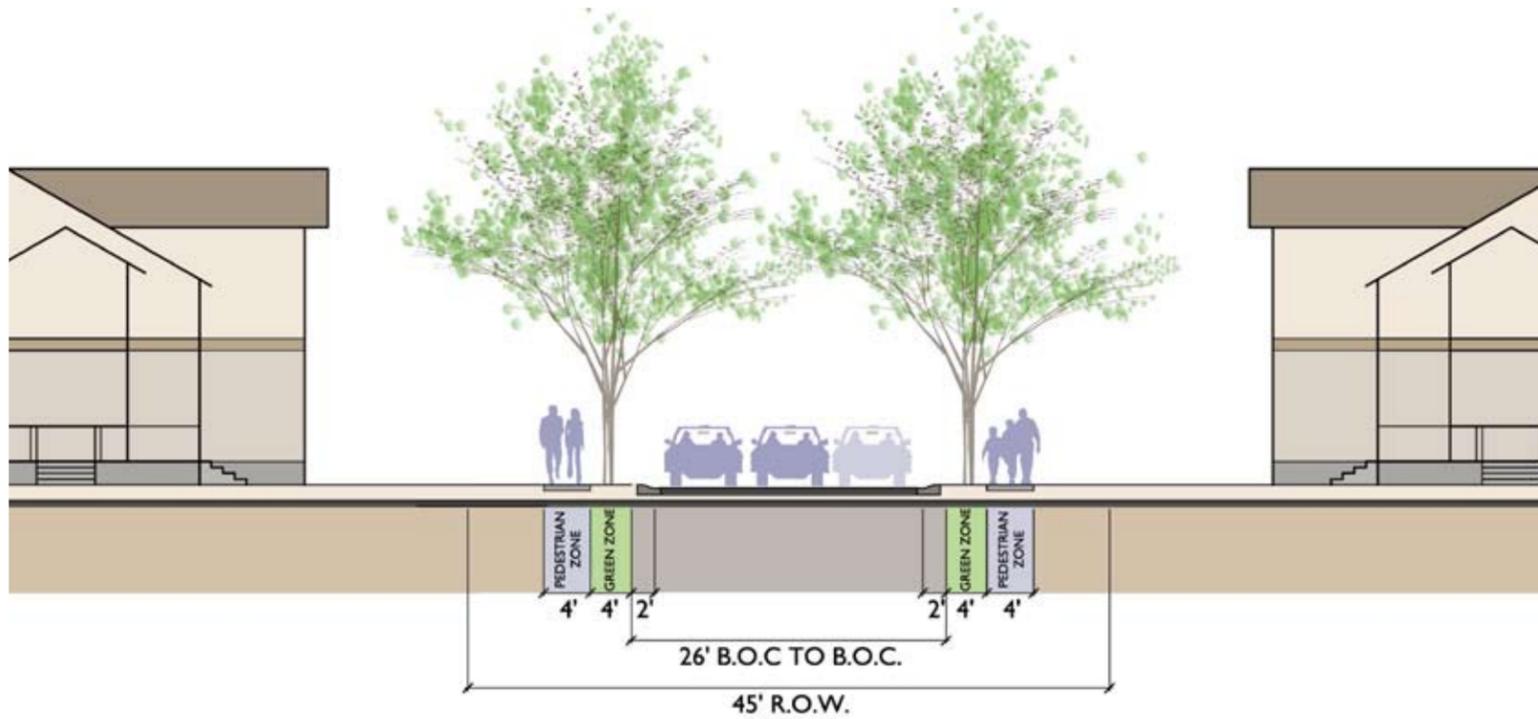


40' LOCAL LIMITED RESIDENTIAL R.O.W. STREET SECTION

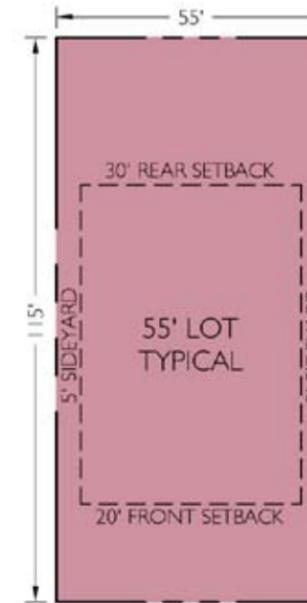
# 1

## STREET SECTIONS

Existing Regulations plan used two different street sections: Local limited residential and local residential.



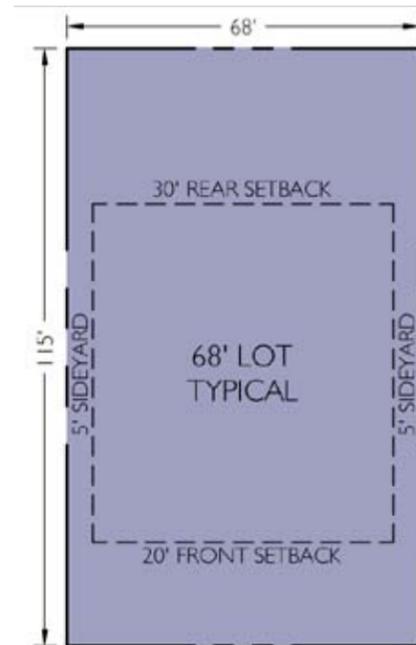
45' LOCAL RESIDENTIAL R.O.W. STREET SECTION



# 2

## 55' LOT TYPICAL

Lot types with dimensions and setbacks remain constant throughout single family case studies.



# 3

## 68' LOT TYPICAL

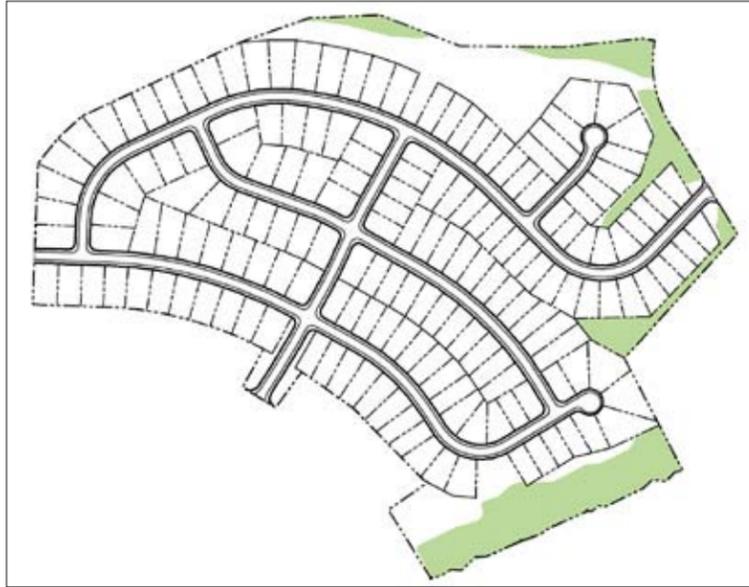
Lot types with dimensions and setbacks remain constant throughout single family case studies.



# 4

## GRADING PLAN

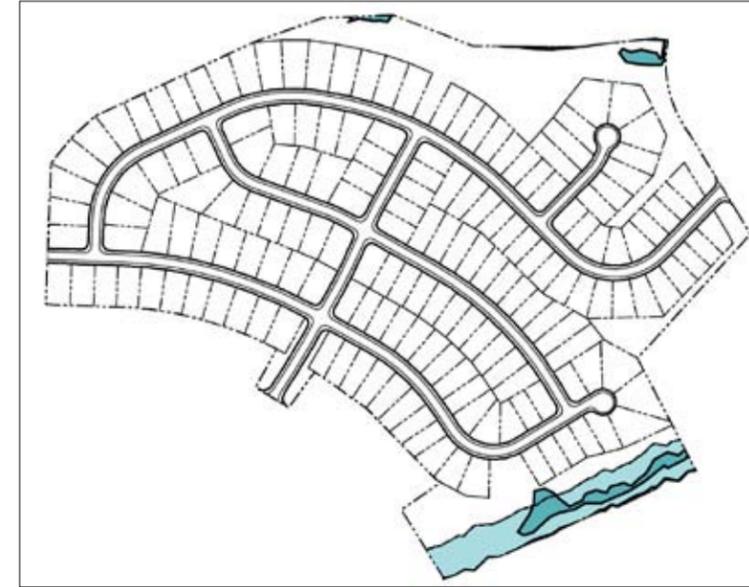
The project was cleared and mass-graded to meet the builder's design of slab-on-grade home product to minimum lot dimension.



# 1

## UNDISTURBED OPEN SPACE

Undisturbed open space is not required under existing zoning. The Existing Regulations - Water Supply Protection plan is required to provide 10% open space, but the open space does not need to be undisturbed. The Existing Regulations - Water Supply Protection plan provided 5 acres (9.6%) of undisturbed open space.



# 3

## BUFFERS AND WETLANDS

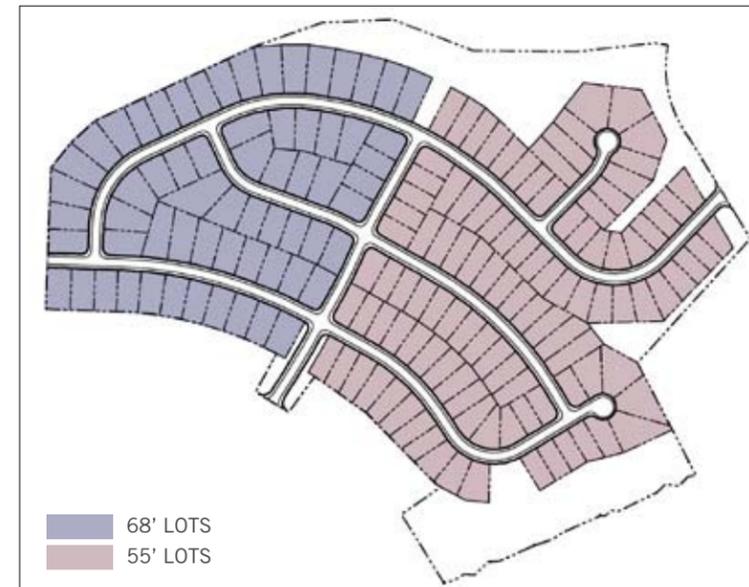
A 100-foot undisturbed buffer is required on the stream on the eastern property boundary. No buffer is required on the intermittent stream on the western property boundary. Wetland buffers were provided per 404 permit standard conditions.



# 2

## TREE SAVE

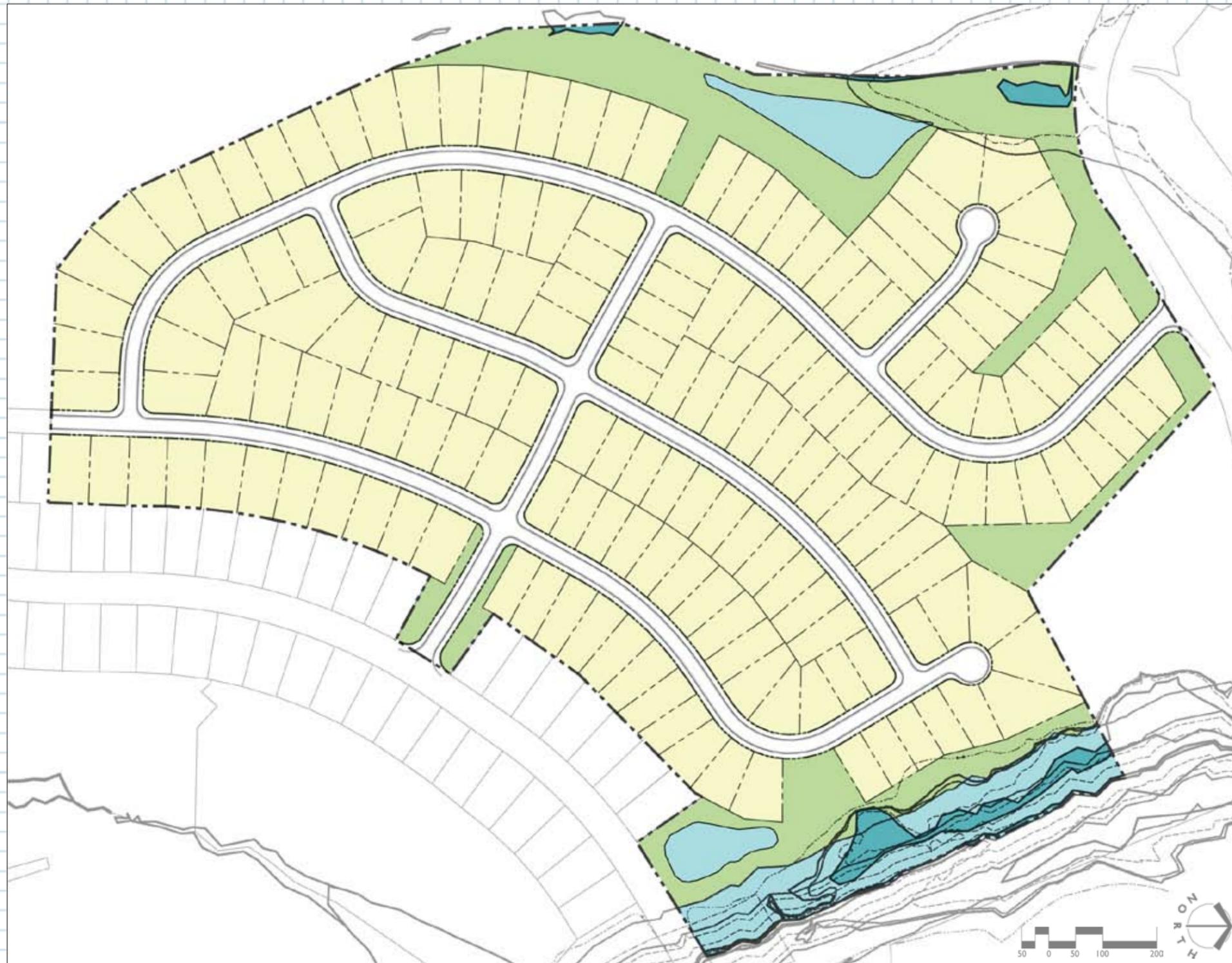
Existing zoning is required to provide 10% tree save. The Existing Regulations - Water Supply Protection plan provided slightly more than the required 10% tree save.



# 4

## LOT MIX

The Existing Regulations - Water Supply Protection consists of two lot sizes: 68' lots and 55' lots.



### DEVELOPMENT SUMMARY

- ❑ ZONING: MX-1
- ❑ SITE ACREAGE: 51.9
- ❑ 55' LOTS: 107
- ❑ 68' LOTS: 64
- ❑ TOTAL LOTS: 171
- ❑ DUA\*: 3.29
- ❑ PUBLIC STREETS (LF): 7,247.3 LF
- ❑ PERCENT IMPERVIOUS: 44%
- ❑ OPEN SPACE REQUIRED\* (AC): 5.2 AC (10%)
- ❑ OPEN SPACE PROVIDED (AC): 9.9 AC (19%)
- ❑ TREE SAVE REQUIRED\* (AC): 5.2 AC (10%)
- ❑ TREE SAVE PROVIDED (AC): 6 AC (11.5%)
- ❑ UNDISTURBED OPEN SPACE REQUIRED (AC): N/R
- ❑ UNDISTURBED OPEN SPACE PROVIDED\* (AC): 5 AC (9.6%)
- ❑ MITIGATED UNDISTURBED OPEN SPACE (AC): N/R
- ❑ BMP - WET PONDS: 40,500 SF
- ❑ OFF-SITE IMPROVEMENTS: N/R

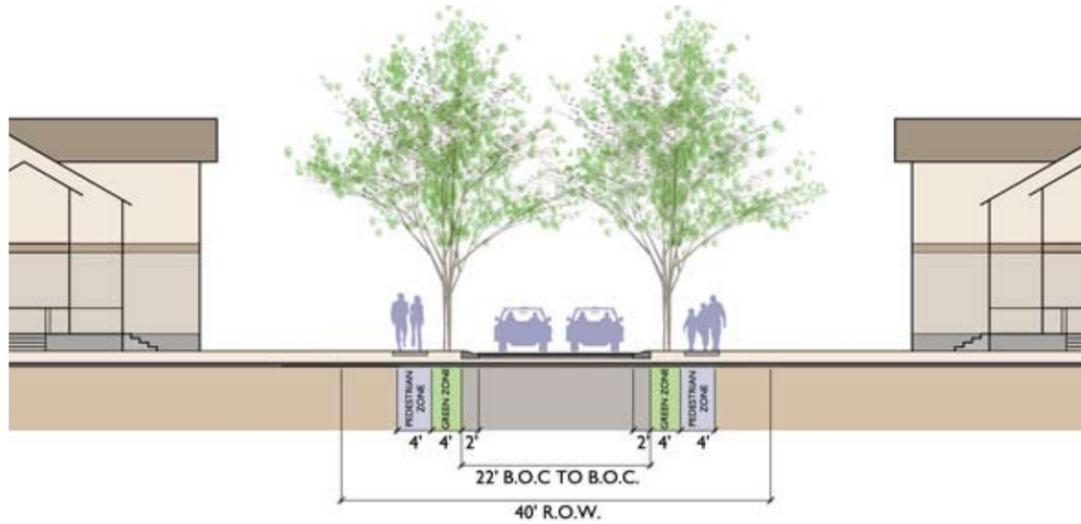
### COST ESTIMATE SUMMARY

- ❑ ALLOWANCES: \$37,800
- ❑ SITE GRADING: \$1,591,100
- ❑ PAVING: \$1,089,300
- ❑ STORM DRAINAGE: \$1,485,100
- ❑ WET DETENTION PONDS: \$100,900
- ❑ PRE DEVELOPMENT EROSION CONTROL: \$109,800
- ❑ POST DEVELOPMENT EROSION CONTROL: \$139,600
- ❑ LANDSCAPING AT ENTRY: \$5,600
- ❑ WATER & SANITARY SEWER: \$1,853,400
- ❑ OPEN SPACE MITIGATION: N/R
- ❑ LITTORAL SHELF PLANTING: \$26,400
- ❑ **TOTAL: \$6,439,100**

### NOTES

The Existing Regulations - Water Supply Protection plan provided 171 lots at a DUA of 3.29. The Existing Regulations - Water Supply Protection plan was designed maximizing developable area. Open space provided was a product of tree save, detention and buffer requirements.

\* See Appendix for definitions.

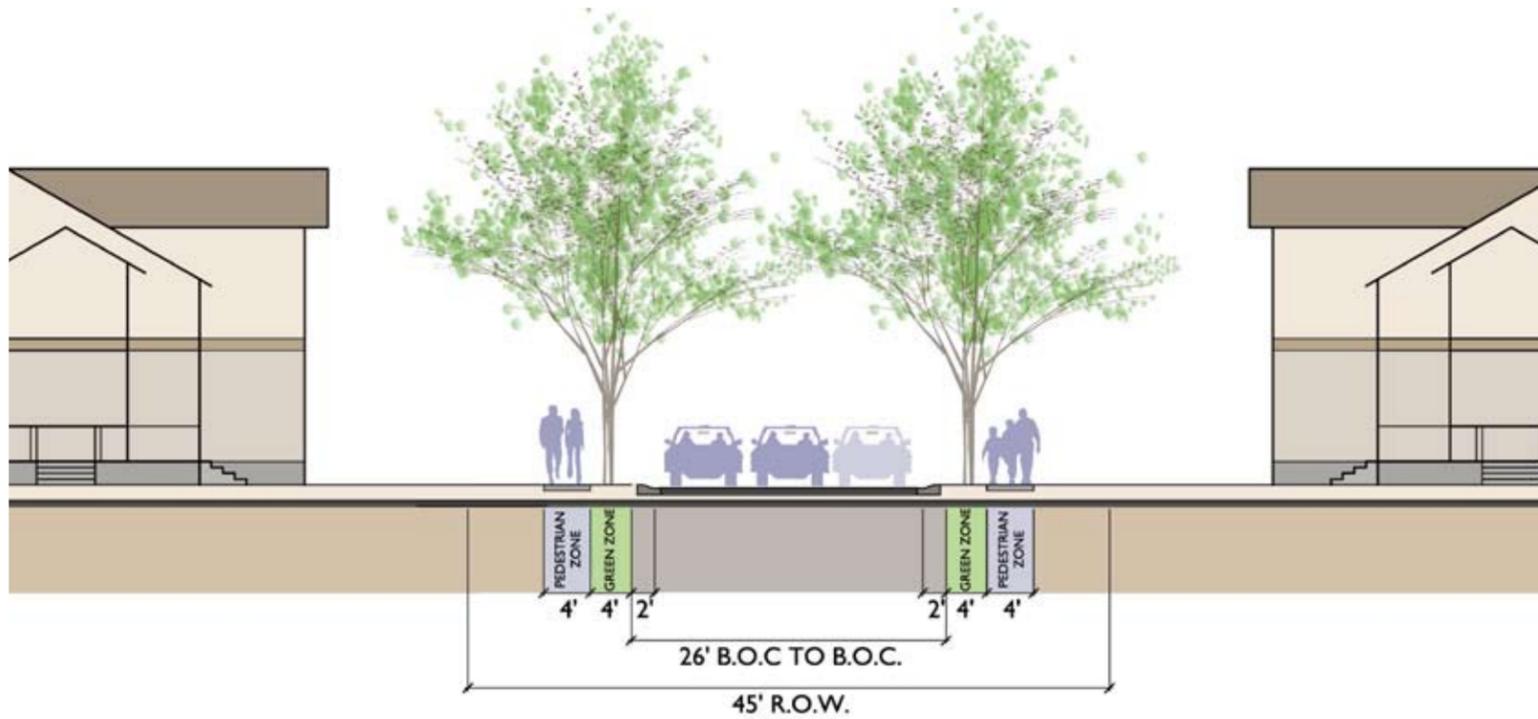


40' LOCAL LIMITED RESIDENTIAL R.O.W. STREET SECTION

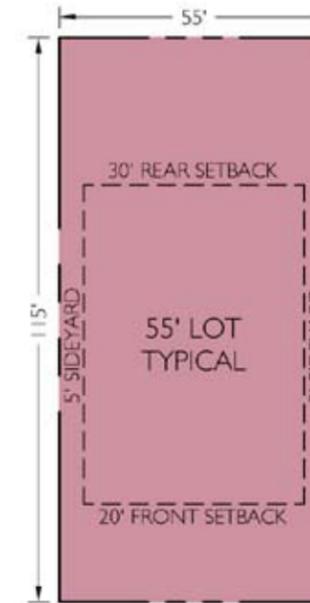
# 1

## STREET SECTIONS

Existing Regulations - Water Supply Protection plan used two different street sections: Local limited residential and local residential.



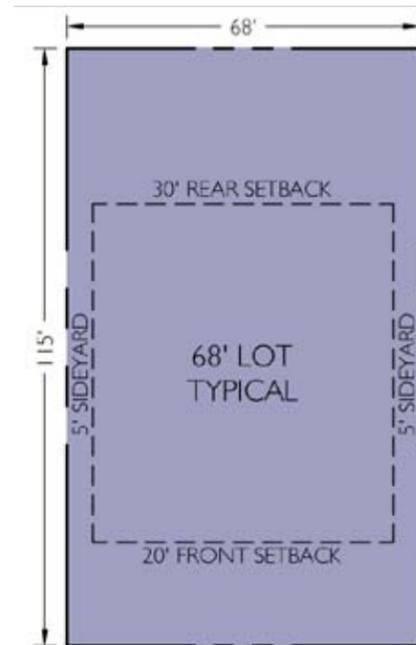
45' LOCAL RESIDENTIAL R.O.W. STREET SECTION



# 2

## 55' LOT TYPICAL

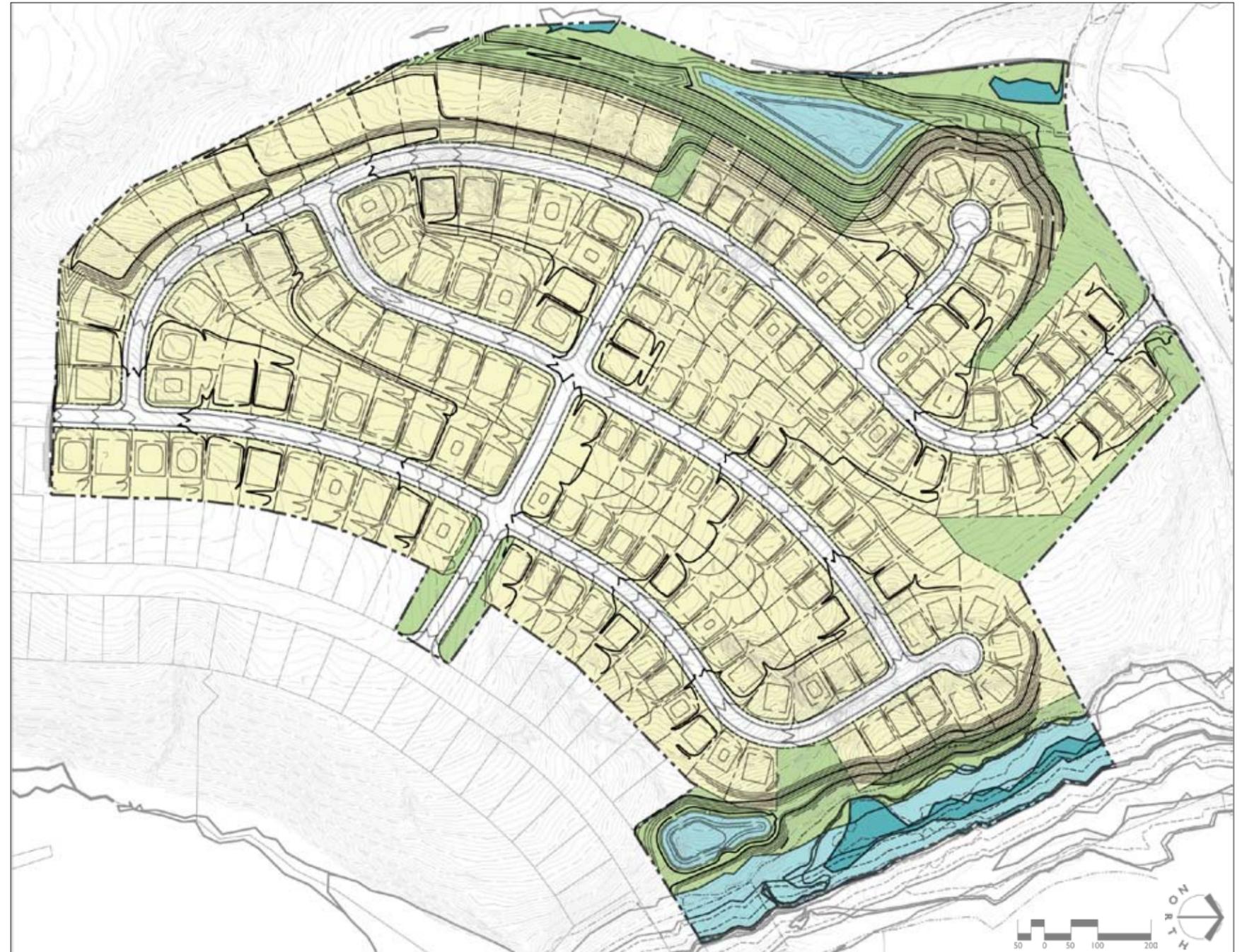
Lot types with dimensions and setbacks remain constant throughout single family case studies.



# 3

## 68' LOT TYPICAL

Lot types with dimensions and setbacks remain constant throughout single family case studies.



# 4

## GRADING PLAN

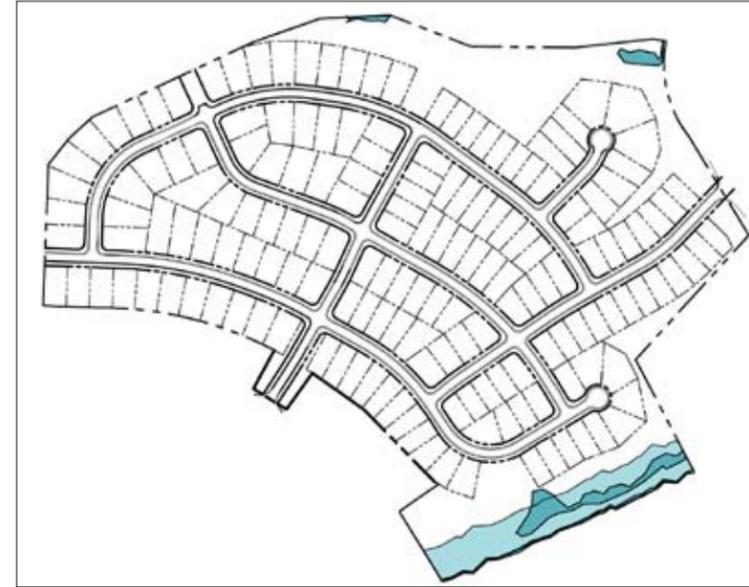
The project was cleared and mass-graded to meet the builder's design of slab-on-grade home product to minimum lot dimension.



# 1

## UNDISTURBED OPEN SPACE

USDG case study does not require any additional water quality than the approved plan. Therefore USDG as the approved plan does not require undisturbed open space. The amount of undisturbed open space provided with the USDG case study is less than the approved plan because of additional linear feet of road required.



# 3

## BUFFERS AND WETLANDS

The USDG as the approved plan is required to provide a 100-foot undisturbed buffer at the stream on the eastern property boundary. No buffer is required at the intermittent stream on the western property boundary. Wetland buffers were provided per 404 permit standard conditions.



# 2

## TREE SAVE

USDG, as with the approved plan, is required to provide 10% tree save. The USDG plan provided the minimum 10% tree save. The slight decrease in tree save from approved plan is due to reduced block lengths resulting in more linear feet of street and more use of developable area to avoid lot loss.



# 4

## LOT MIX

For consistency with the approved plan USDG plan consists of two lot sizes: 68' lots and 55' lots. The same lot sizes and mix were assumed.



### DEVELOPMENT SUMMARY

- ❑ ZONING: MX-1
- ❑ SITE ACREAGE: 51.9
- ❑ 55' LOTS: 105
- ❑ 68' LOTS: 63
- ❑ TOTAL LOTS: 168
- ❑ DUA\*: 3.24
- ❑ PUBLIC STREETS (LF): 7,921 LF
- ❑ PERCENT IMPERVIOUS: 44%
- ❑ OPEN SPACE REQUIRED\* (AC): 5.2 (10%)
- ❑ OPEN SPACE PROVIDED (AC): 10.5 (20.3%)
- ❑ TREE SAVE REQUIRED\* (AC): 5.2 (10%)
- ❑ TREE SAVE PROVIDED (AC): 5.2 (10%)
- ❑ UNDISTURBED OPEN SPACE REQUIRED\* (AC): N/R
- ❑ UNDISTURBED OPEN SPACE PROVIDED (AC): 4.75 (9.1%)
- ❑ MITIGATED UNDISTURBED OPEN SPACE (AC): N/R
- ❑ BMP - WET PONDS: 40,500 SF
- ❑ OFF-SITE IMPROVEMENTS: N/R

### COST ESTIMATE SUMMARY

- ❑ ALLOWANCES: \$37,840.00
- ❑ SITE GRADING: \$1,599,800
- ❑ PAVING: \$1,347,600
- ❑ STORM DRAINAGE: \$1,540,100
- ❑ WET DETENTION PONDS: \$120,800
- ❑ PRE DEVELOPMENT EROSION CONTROL: \$109,800
- ❑ POST DEVELOPMENT EROSION CONTROL: \$139,600
- ❑ LANDSCAPING AT ENTRY: \$5,600
- ❑ WATER & SANITARY SEWER: \$1,820,900
- ❑ LITTORAL SHELF PLANTING: \$26,400
- ❑ OPEN SPACE MITIGATION: N/R
- ❑ **TOTAL: \$6,748,400**

### NOTES

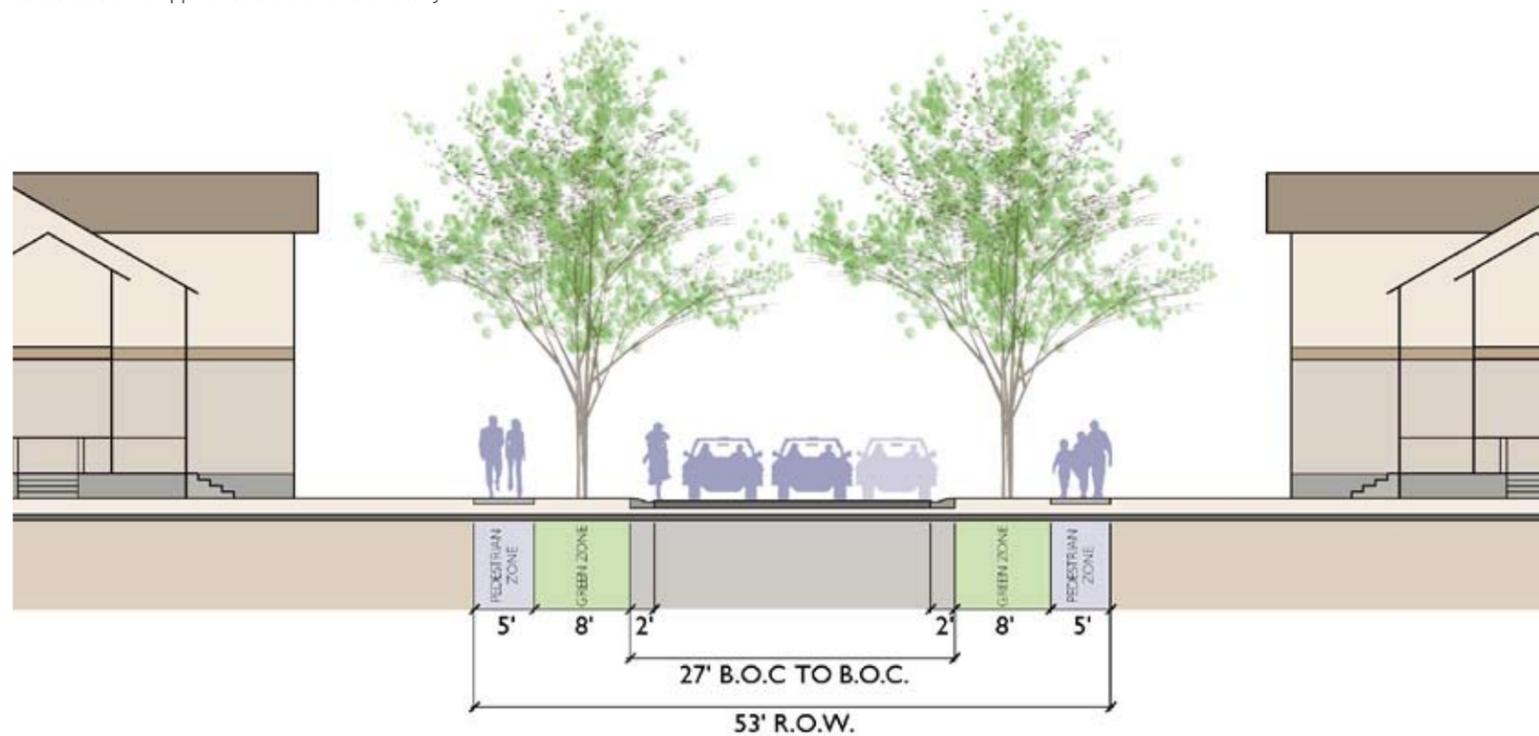
Urban Street Design Guidelines was the only change application from the Approved Plan. Buildable site planning changes were made to accommodate the 53' R.O.W. Reduced block lengths and R.O.W. stub connection to adjacent property resulted in a reduction of three (3) lots. Lot sizes and mix were held constant.

\* See Appendix for definitions.

# 1

## STREET SECTION

Urban Street Design Guidelines medium residential street section is applied to the USDG case study.



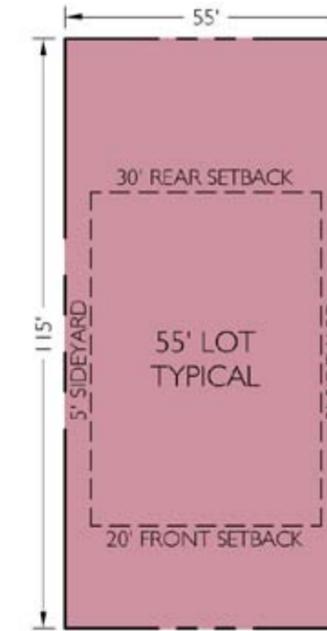
### USDG - MEDIUM RESIDENTIAL STREET SECTION

Note: USDG will allow for a 50' R.O.W. should there be a sidewalk easement provided for public sidewalks. This R.O.W. dimension was not utilized with this analysis as additional project density would not be realized.

# 2

## 55' LOT TYPICAL

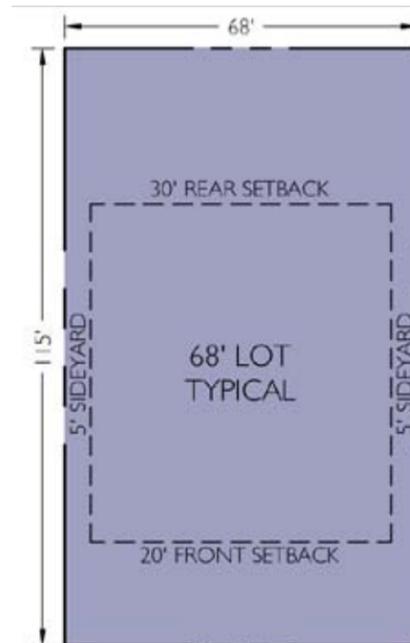
Lot types with dimensions and setbacks remain constant throughout single family case studies, for comparative purposes. Changes in dimensions or mix of lot sizes would yield different results.



# 3

## 68' LOT TYPICAL

Lot types with dimensions and setbacks remain constant throughout single family case studies, or comparative purposes. Changes in dimensions or mix of lot sizes would yield different results.





# 4

## GRADING PLAN

USDG and approved plan have very similar grading plans. Minor grading changes are made to accommodate the USDG which introduced additional roadway to meet block length and stub connection requirements. Wet detention pond grading remains constant.



# 1

## UNDISTURBED OPEN SPACE

Minimum Permit Requirements, as with the USDG and approved plan, is not required to provide undisturbed open space. The Minimum Permit Requirements provided 4.75 AC (9.1%) of undisturbed open space.



# 3

## BUFFERS AND WETLANDS

The Minimum Permit Requirements case study as USDG and approved plan is required to provide a 100-foot undisturbed buffer at the stream on the eastern property boundary. A 30-foot no-build buffer is required at the intermittent stream on the western property boundary. Wetland buffers were provided per 404 Permit standard conditions.



# 2

## TREE SAVE

Minimum Permit Requirements plan as with the USDG and approved plan is required to provide 10% tree save. The Minimum Permit Requirements plan provided slightly more than 10% tree save due to buffer requirements.



# 4

## LOT MIX

For consistency with the approved plan, the Minimum Permit Requirements Plan consists of two lot sizes: 68' lots and 55' lots. The same lot sizes and mix were assumed.



### DEVELOPMENT SUMMARY

- ❑ ZONING: MX-1
- ❑ SITE ACREAGE: 51.9
- ❑ 55' LOTS: 105
- ❑ 68' LOTS: 63
- ❑ TOTAL LOTS: 168
- ❑ DUA\*: 3.24
- ❑ PUBLIC STREETS (LF): 7,921 LF
- ❑ PERCENT IMPERVIOUS: 44%
- ❑ OPEN SPACE REQUIRED\* (AC): 5.2 (10%)
- ❑ OPEN SPACE PROVIDED (AC): 10.5 (20.3%)
- ❑ TREE SAVE REQUIRED\* (AC): 5.2 (10%)
- ❑ TREE SAVE PROVIDED (AC): 5.2 (10%)
- ❑ UNDISTURBED OPEN SPACE REQUIRED\* (AC): N/R
- ❑ UNDISTURBED OPEN SPACE PROVIDED (AC): 4.75 (9.1%)
- ❑ MITIGATED UNDISTURBED OPEN SPACE (AC): N/R
- ❑ BMP - WET PONDS: 40,500 SF
- ❑ OFF-SITE IMPROVEMENTS: N/R

### COST ESTIMATE SUMMARY

- ❑ ALLOWANCES: \$37,800
- ❑ SITE GRADING: \$1,599,800
- ❑ PAVING: \$1,347,600
- ❑ STORM DRAINAGE: \$1,540,100
- ❑ WET DETENTION PONDS: \$120,800
- ❑ PRE DEVELOPMENT EROSION CONTROL: \$109,800
- ❑ POST DEVELOPMENT EROSION CONTROL: \$139,600
- ❑ LANDSCAPING AT ENTRY: \$5,600
- ❑ WATER & SANITARY SEWER: \$1,820,900
- ❑ LITTORAL SHELF PLANTING: \$26,400
- ❑ OPEN SPACE MITIGATION: N/R
- ❑ **TOTAL: \$6,748,400**

### NOTES

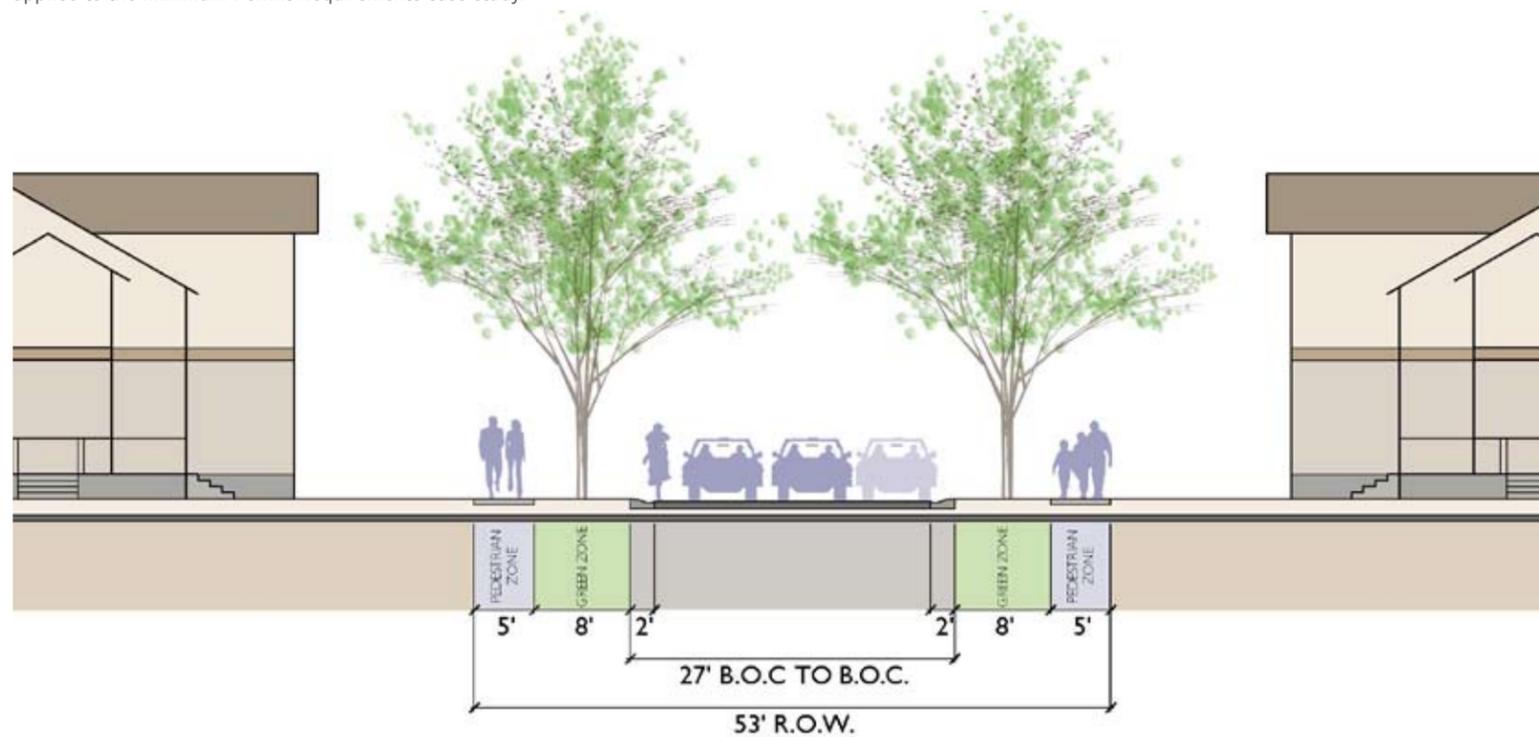
Minimum Permit Requirements\* is combination of USDG (applied to all case studies) and Minimum Permit Requirements\*. The Minimum Permit Requirements\* were a slight increase in water quality and detention requirements when compared with the Existing Water Supply Protection Regulations requirements. Therefore the Minimum Permit Requirements\* did not significantly alter the plan when compared with the USDG plan that included Water Supply Protection Regulations requirements.

\* See Appendix for definitions.

# 1

## STREET SECTION

Urban Street Design Guidelines medium residential street section is applied to the Minimum Permit Requirements case study.



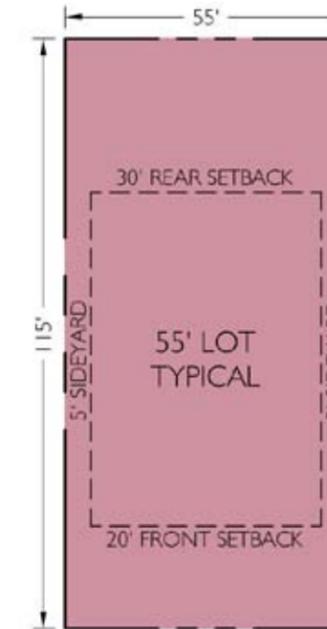
### USDG - MEDIUM RESIDENTIAL STREET SECTION

Note: USDG will allow for a 50' R.O.W. should there be a sidewalk easement provided for public sidewalks. This R.O.W. dimension was not utilized with this analysis as additional project density would not be realized.

# 2

## 55' LOT TYPICAL

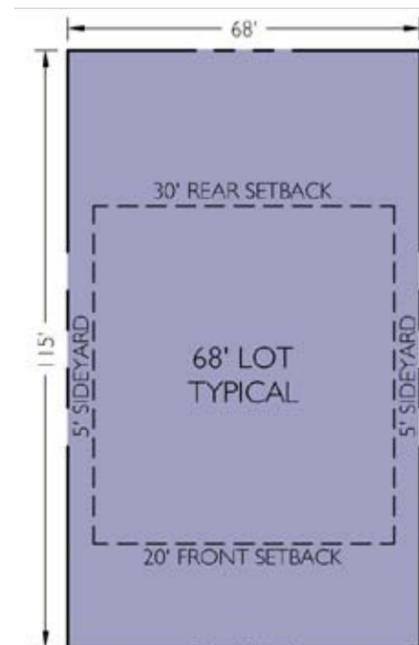
Lot types with dimensions and setbacks remain constant throughout single family case studies, for comparative purposes. Changes in dimensions or mix of lot sizes would yield different results.



# 3

## 68' LOT TYPICAL

Lot types with dimensions and setbacks remain constant throughout single family case studies, for comparative purposes. Changes in dimensions or mix of lot sizes would yield different results.





# 4

## GRADING PLAN

Minor layout changes when compared with USDG did not require major grading changes therefore the grading plans are very similar.



### 1 UNDISTURBED OPEN SPACE

The PCCO-Central Catawba plan is required to provide 17.5% of undisturbed open space. On-site mitigation is used to meet undisturbed open space requirements without major reduction in lots. In places, a 15-foot easement is placed at the rear of lots for on-site mitigation.



### 3 BUFFERS AND WETLANDS

A 35' buffer is required for the intermittent stream to the west of the site. No increase on 100' undisturbed buffer is required of the stream to the east of the site.



### 2 TREE SAVE

Tree save totaled 5.5 AC. The tree save is a slight increase compared with Existing Regulations due to grading changes and 35' undisturbed buffer on the intermittent stream.



### 4 LOT MIX

For consistency with the approved plan, the PCCO-Central Catawba plan consists of two lot sizes: 68' lots and 55' lots. The same lot sizes and mix were assumed.



### DEVELOPMENT SUMMARY

- ❑ ZONING: MX-1
- ❑ SITE ACREAGE: 51.9
- ❑ 55' LOTS: 100
- ❑ 68' LOTS: 62
- ❑ TOTAL LOTS: 162
- ❑ DUA\*: 3.10
- ❑ PUBLIC STREETS (LF): 7,780.3 LF
- ❑ PERCENT IMPERVIOUS: 44%
- ❑ OPEN SPACE REQUIRED\* (AC): 5.2 (10%)
- ❑ OPEN SPACE PROVIDED (AC): 13.1 (25.2%)
- ❑ TREE SAVE REQUIRED\* (AC): 5.2 (10%)
- ❑ TREE SAVE PROVIDED (AC): 5.5 (10.6%)
- ❑ UNDISTURBED OPEN SPACE REQUIRED\* (AC): 9.08 (17.5%)
- ❑ UNDISTURBED OPEN SPACE PROVIDED (AC): 4.8 (9.5%)
- ❑ MITIGATED UNDISTURBED OPEN SPACE (AC): 6.35
- ❑ BMP - WET PONDS: 79,100 SF
- ❑ OFF-SITE IMPROVEMENTS: N/A

### COST ESTIMATE SUMMARY

- ❑ ALLOWANCES: \$37,800
- ❑ SITE GRADING: \$1,525,100
- ❑ PAVING: \$1,323,700
- ❑ STORM DRAINAGE: \$1,552,700
- ❑ WET DETENTION PONDS: \$108,300
- ❑ PRE DEVELOPMENT EROSION CONTROL: \$109,800
- ❑ POST DEVELOPMENT EROSION CONTROL: \$139,600
- ❑ LANDSCAPING AT ENTRY: \$5,600
- ❑ WATER & SANITARY SEWER: \$1,745,000
- ❑ OPEN SPACE MITIGATION: \$44,500
- ❑ LITTORAL SHELF PLANTING: \$116,100
- ❑ **TOTAL: \$6,708,100**

### NOTES

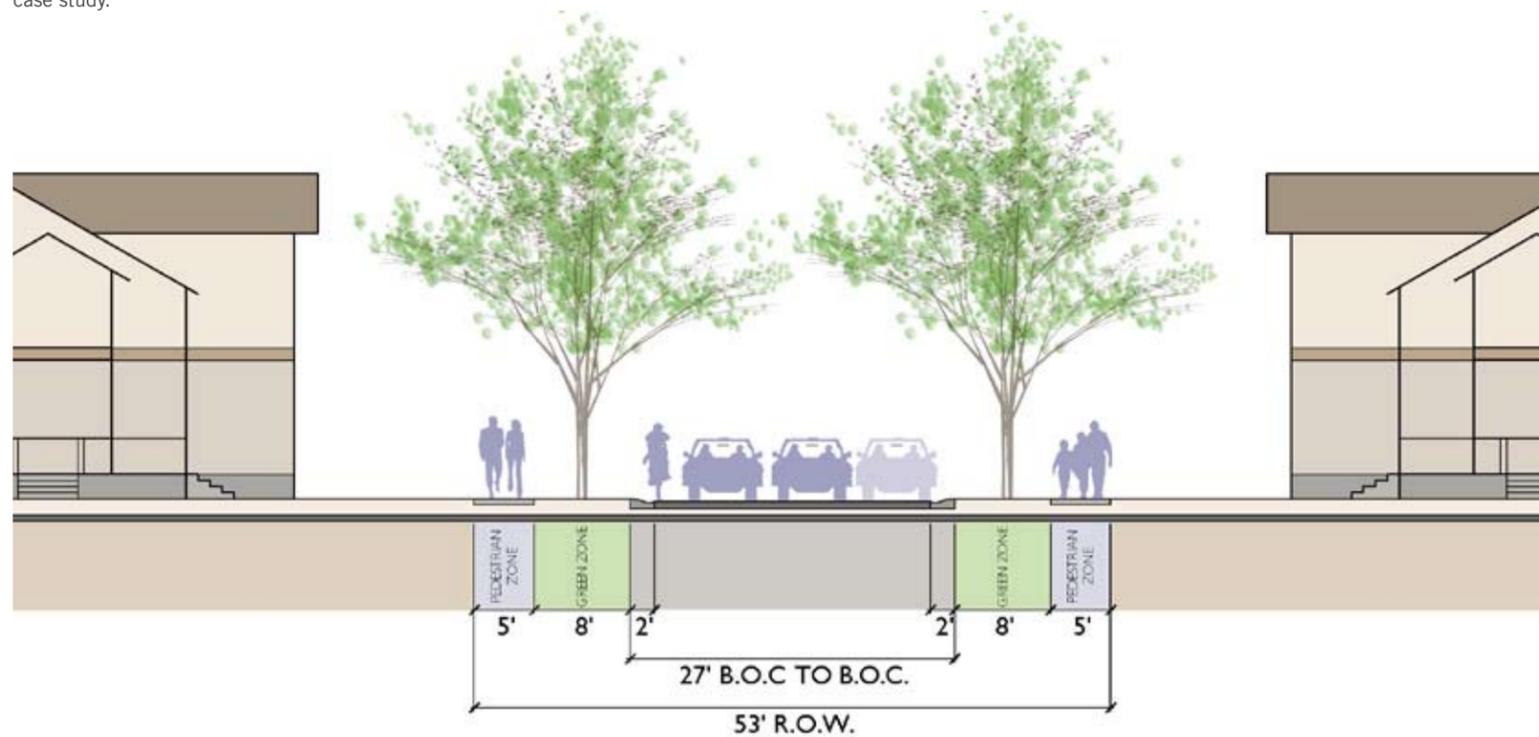
Total number of lots is reduced in PCCO-Central plan as wet ponds increase in size. The 35' undisturbed buffer to the west of the site also plays a role in loss of lots. On-site mitigation is used along the rear of lots to satisfy the undisturbed open space requirements.

\* See Appendix for definitions.

# 1

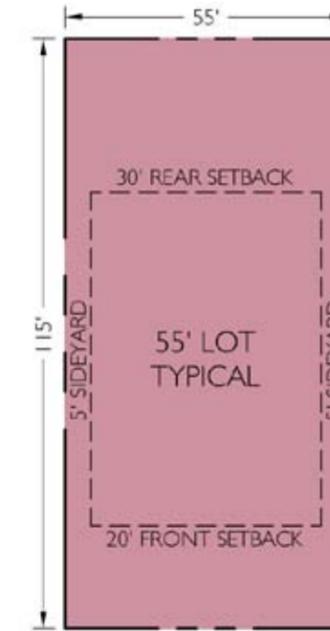
## STREET SECTION

Urban Street Design Guidelines medium residential street section is applied to the PCCO-Central Catawba case study.



### USDG - MEDIUM RESIDENTIAL STREET SECTION

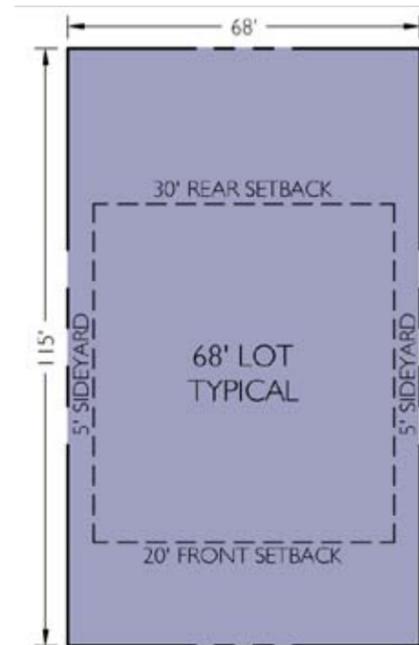
Note: USDG will allow for a 50' R.O.W. should there be a sidewalk easement provided for public sidewalks. This R.O.W. dimension was not utilized with this analysis as additional project density would not be realized.



# 2

## 55' LOT TYPICAL

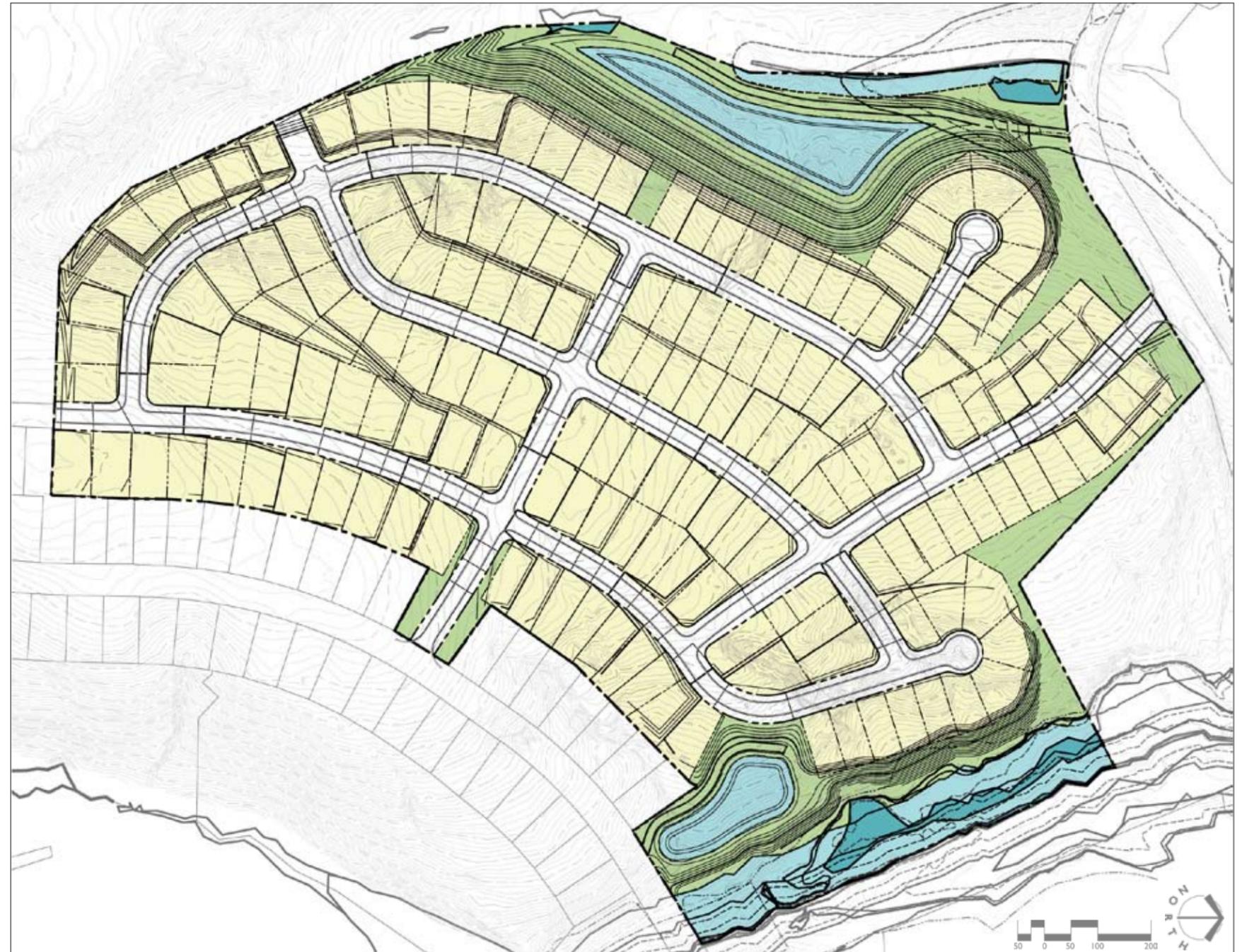
Lot types with dimensions and setbacks remain constant throughout single family case studies, for comparative purposes. Changes in dimensions or mix of lot sizes would yield different results.



# 3

## 68' LOT TYPICAL

Lot types with dimensions and setbacks remain constant throughout single family case studies, for comparative purposes. Changes in dimensions or mix of lot sizes would yield different results.



# 4

## GRADING PLAN

East wet pond increase in size results in 3 fewer lots (lot size and mix assumed constant) and grading becomes 3:1 after 10' shoulder off road. Additional planting may be required to screen steep slopes and BMPs new visibility from road. 2:1 Dam slopes are retained and consistent with approved plan. West wet pond increase of 0.28 acres resulted in 3 fewer lots. The 30' of fall to wet pond is consistent with approved plan.



# 1

## UNDISTURBED OPEN SPACE

The PCCO-Western Catawba plan is required to provide 17.5% of undisturbed open space. On-site mitigation is used to meet undisturbed open space requirements without major reduction in lots. In places, a 15-foot easement is placed at the rear of lots for on-site mitigation.



# 3

## BUFFERS AND WETLANDS

A 35' buffer is required for the intermittent stream to the west of the site. No increase on 100' undisturbed buffer is required of the stream to the east of the site.



# 2

## TREE SAVE

Tree save totaled 5.5 AC. The tree save is a slight increase compared with Existing Regulations. The increase is due to grading changes and 35' undisturbed intermittent stream buffer.



# 4

## LOT MIX

For consistency with the approved plan, the PCCO-Western Catawba plan consists of two lot sizes: 68' lots and 55' lots. The same lot sizes and mix were assumed.



### DEVELOPMENT SUMMARY

- ❑ ZONING: MX-1
- ❑ SITE ACREAGE: 51.9
- ❑ 55' LOTS: 100
- ❑ 68' LOTS: 62
- ❑ TOTAL LOTS: 162
- ❑ DUA\*: 3.10
- ❑ PUBLIC STREETS (LF): 7,780.3 LF
- ❑ PERCENT IMPERVIOUS: 44%
- ❑ OPEN SPACE REQUIRED\* (AC): 5.2 (10%)
- ❑ OPEN SPACE PROVIDED (AC): 13.1 (25.2%)
- ❑ TREE SAVE REQUIRED\* (AC): 5.2 (10%)
- ❑ TREE SAVE PROVIDED (AC): 5.5 (10.6%)
- ❑ UNDISTURBED OPEN SPACE REQUIRED\* (AC): 9.08(17.5%)
- ❑ UNDISTURBED OPEN SPACE PROVIDED (AC): 4.8 (9.5%)
- ❑ MITIGATED UNDISTURBED OPEN SPACE (AC): 6.35
- ❑ BMP - WET PONDS: 79,100 SF
- ❑ OFF-SITE IMPROVEMENTS: N/A

### COST ESTIMATE SUMMARY

- ❑ ALLOWANCES: \$37,800
- ❑ SITE GRADING: \$1,525,100
- ❑ PAVING: \$1,323,700
- ❑ STORM DRAINAGE: \$1,552,700
- ❑ WET DETENTION PONDS: \$108,300
- ❑ PRE DEVELOPMENT EROSION CONTROL: \$109,800
- ❑ POST DEVELOPMENT EROSION CONTROL: \$139,600
- ❑ LANDSCAPING AT ENTRY: \$5,600
- ❑ WATER & SANITARY SEWER: \$1,745,000
- ❑ OPEN SPACE MITIGATION: \$116,100
- ❑ LITTORAL SHELF PLANTING: \$44,500
- ❑ **TOTAL: \$6,708,100**

### NOTES

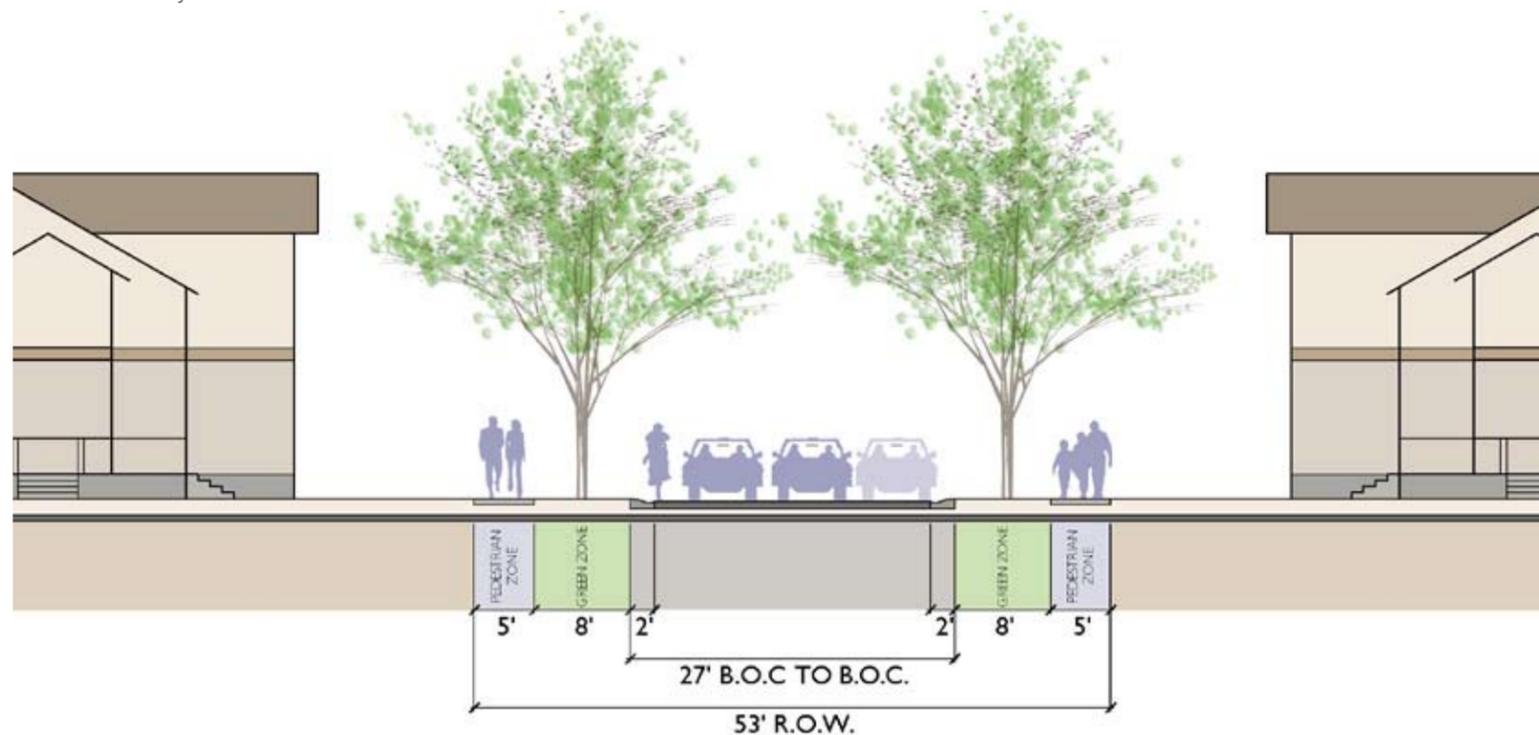
Total number of lots is reduced in PCCO-Western plan as wet ponds increase in size. The 35' undisturbed buffer to the west of the site also plays a role in loss of lots. On-site mitigation is used along the rear of lots to satisfy the undisturbed open space requirements. The PCCO-Western plan and PCCO-Central plan have very similar requirements therefore, construction cost and project yield are very similar.

\* See Appendix for definitions.

# 1

## STREET SECTION

Urban Street Design Guidelines medium residential street section is applied to the PCCO-Western Catawba case study.



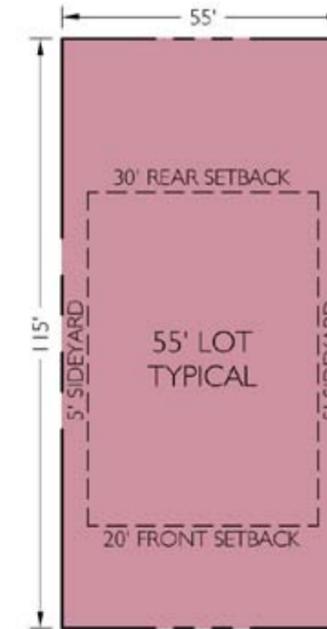
### USDG - MEDIUM RESIDENTIAL STREET SECTION

Note: USDG will allow for a 50' R.O.W. should there be a sidewalk easement provided for public sidewalks. This R.O.W. dimension was not utilized with this analysis as additional project density would not be realized.

# 2

## 55' LOT TYPICAL

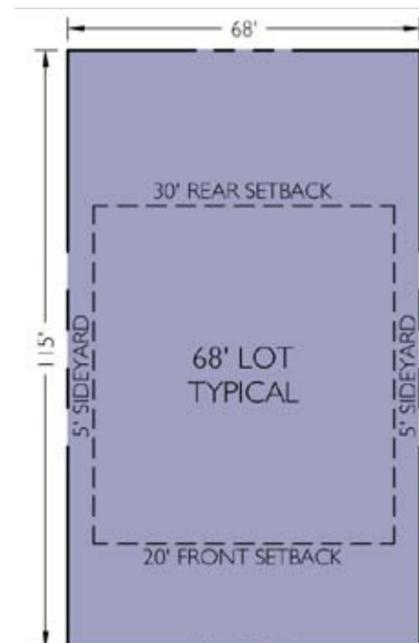
Lot types with dimensions and setbacks remain constant throughout single family case studies, for comparative purposes. Changes in dimensions or mix of lot sizes would yield different results.

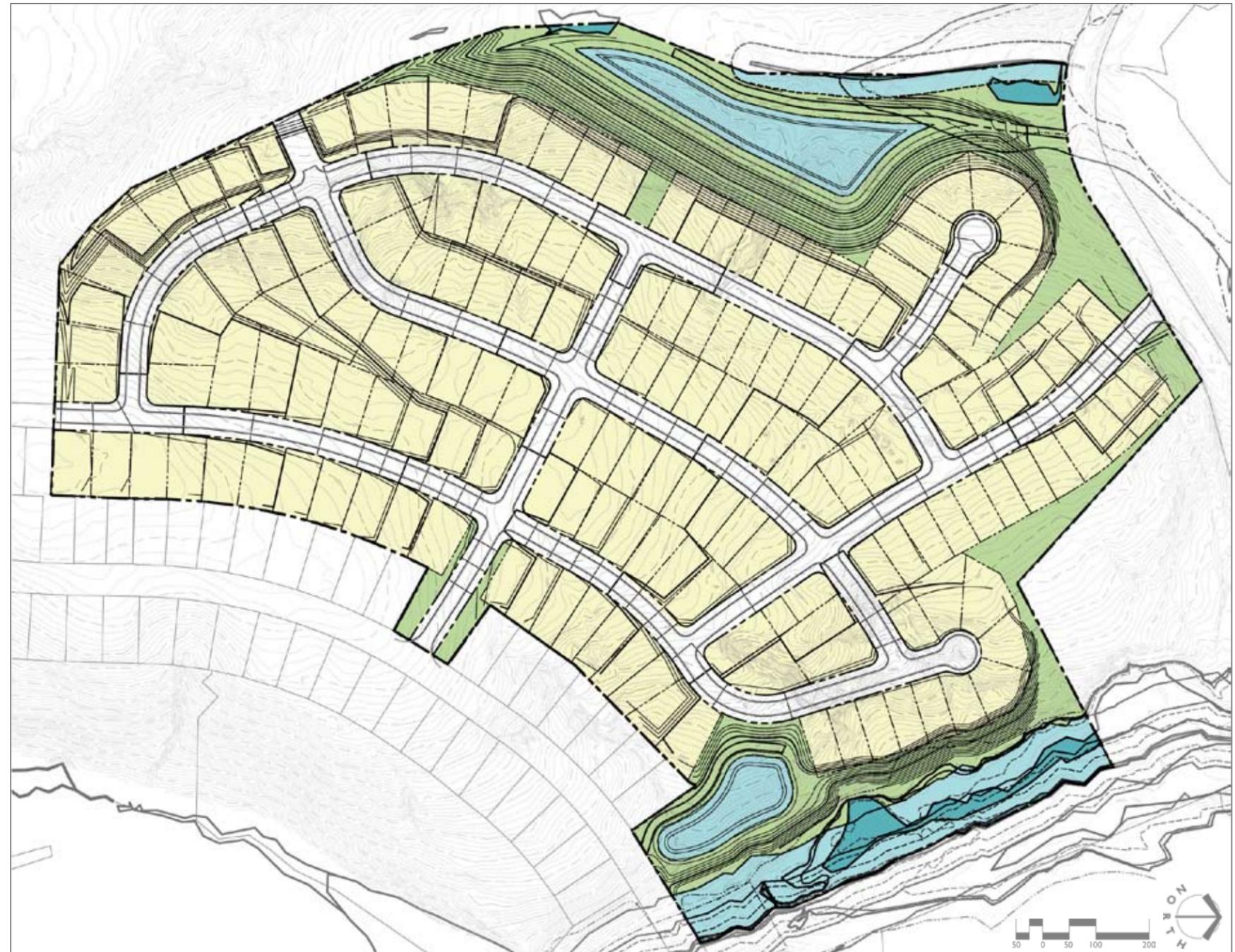


# 3

## 68' LOT TYPICAL

Lot types with dimensions and setbacks remain constant throughout single family case studies, for comparative purposes. Changes in dimensions or mix of lot sizes would yield different results.





# 4

## GRADING PLAN

East wet pond increase in size results in 3 fewer lots (lot size and mix assumed constant) and grading becomes 3:1 after 10' shoulder off road. Additional planting may be required to screen steep slopes and BMPs new visibility from road. 2:1 Dam slopes are retained and consistent with Existing Regulations. West wet pond increase of 0.28 acres resulted in 3 fewer lots. The 30' of fall to wet pond is consistent with Existing Regulations.



# 1

## UNDISTURBED OPEN SPACE

The PCCO-Yadkin plan is required to provide 17.5% of undisturbed open space. Although the PCCO-Yadkin plan provides the most undisturbed open space of any plan, on-site mitigation is used to meet undisturbed open space requirements without major reduction in lots. In a few places, a 15-foot easement is placed at the rear of lots for on-site mitigation.



# 3

## BUFFERS AND WETLANDS

The PCCO-Yadkin watershed requires a 100' undisturbed buffer on all streams. The 100' undisturbed buffer is a 65' buffer increase from PCCO-Central and Western watersheds.



# 2

## TREE SAVE

The increased undisturbed buffers resulted in over an acre or more of tree save provided due to increased amount of land that could not be disturbed. Total tree save provided is 6.4 acres.



# 4

## LOT MIX

For consistency with the approved plan the PCCO-Yadkin plan consists of two lot types: 68' lots and 55' lots. The same lot sizes and mix were assumed.



### DEVELOPMENT SUMMARY

- ❑ ZONING: MX-1
- ❑ SITE ACREAGE: 51.9
- ❑ 55' LOTS: 94
- ❑ 68' LOTS: 62
- ❑ TOTAL LOTS: 156
- ❑ DUA\*: 3.0
- ❑ PUBLIC STREETS (LF): 7,780.3 LF
- ❑ PERCENT IMPERVIOUS: 43%
- ❑ OPEN SPACE REQUIRED\* (AC): 5.2 (10%)
- ❑ OPEN SPACE PROVIDED (AC): 13.9 (26.8%)
- ❑ TREE SAVE REQUIRED\* (AC): 5.2 (10%)
- ❑ TREE SAVE PROVIDED (AC): 6.4 (12.3%)
- ❑ UNDISTURBED OPEN SPACE REQUIRED\* (AC): 9.08 (17.5%)
- ❑ UNDISTURBED OPEN SPACE PROVIDED (AC): 5.78 (11.1%)
- ❑ MITIGATED UNDISTURBED OPEN SPACE (AC): 4.3
- ❑ BMP - WET PONDS: 79,300 SF
- ❑ OFF-SITE IMPROVEMENTS: N/A

### COST ESTIMATE SUMMARY

- ❑ ALLOWANCES: \$37,800
- ❑ SITE GRADING: \$1,523,500
- ❑ PAVING: \$1,323,700
- ❑ STORM DRAINAGE: \$1,564,600
- ❑ WET DETENTION PONDS: \$101,400
- ❑ PRE DEVELOPMENT EROSION CONTROL: \$109,800
- ❑ POST DEVELOPMENT EROSION CONTROL: \$139,600
- ❑ LANDSCAPING AT ENTRY: \$5,600
- ❑ OPEN SPACE MITIGATION: \$78,600
- ❑ WATER & SANITARY SEWER: \$1,680,000
- ❑ LITTORAL SHELF PLANTING: \$43,600
- ❑ **TOTAL: \$6,608,100**

### NOTES

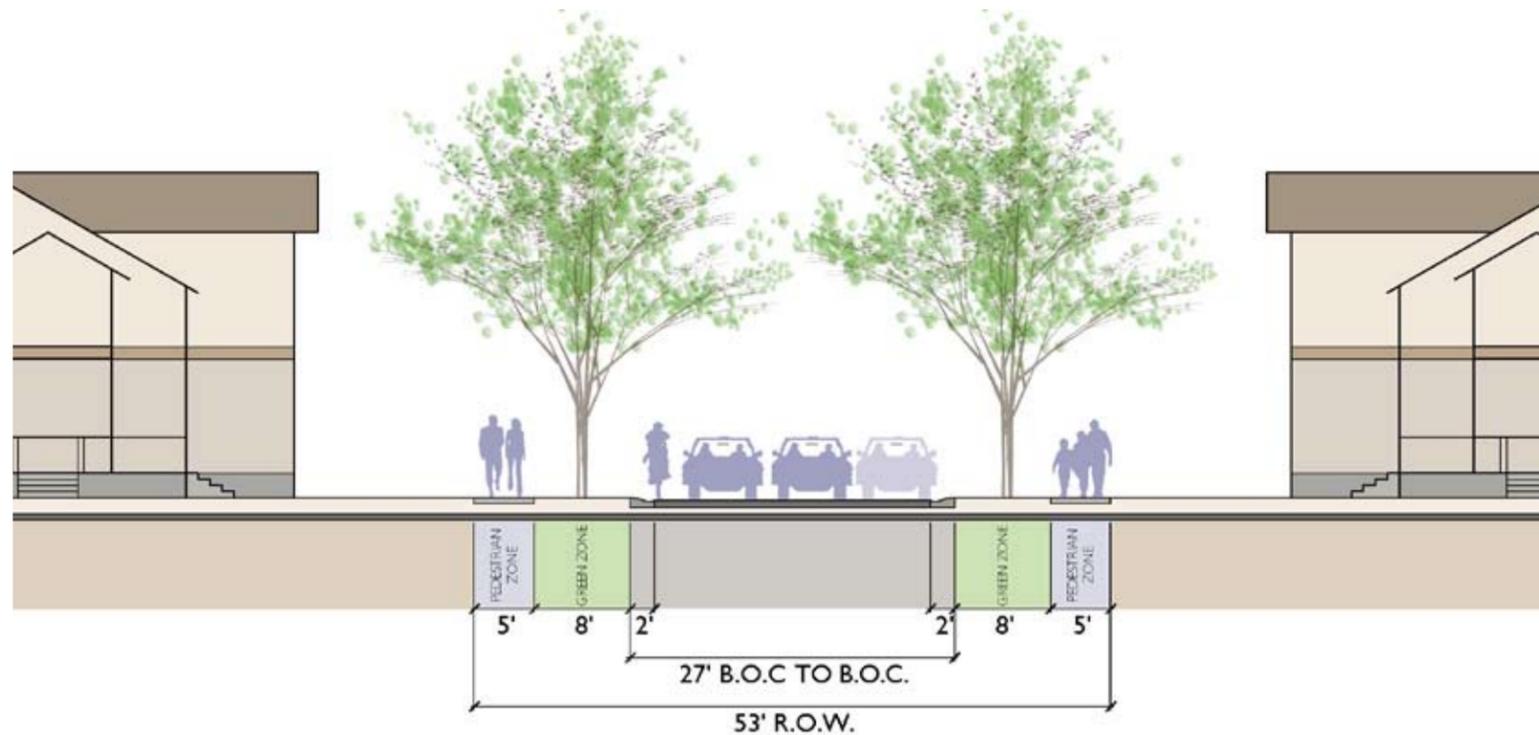
Total number of lots is reduced in PCCO-Yadkin plan due to 100' undisturbed buffer to the west of the site. Water quality requirements are similar to PCCO-Central and Western therefore wet pond size is similar. On-site mitigation is used along the rear of a few lots to satisfy the undisturbed open space requirements.

\* See Appendix for definitions.

# 1

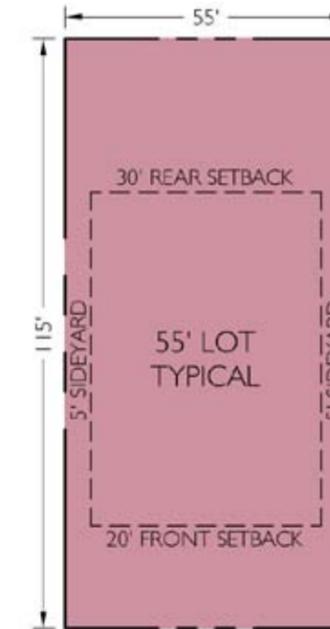
## STREET SECTION

Urban Street Design Guidelines medium residential street section is applied to the PCCO-Yadkin case study.



### USDG - MEDIUM RESIDENTIAL STREET SECTION

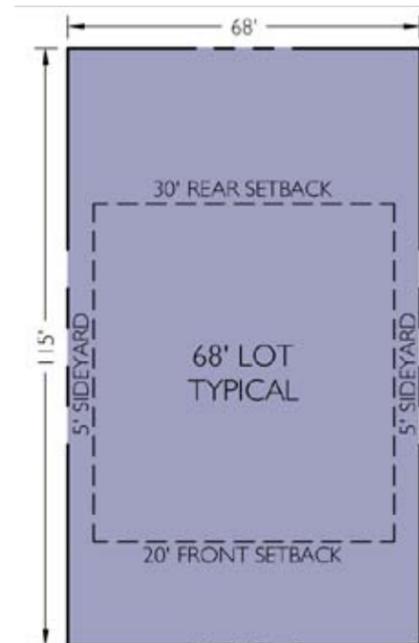
Note: USDG will allow for a 50' R.O.W. should there be a sidewalk easement provided for public sidewalks. This R.O.W. dimension was not utilized with this analysis as additional project density would not be realized.



# 2

## 55' LOT TYPICAL

Lot types with dimensions and setbacks remain constant throughout single family case studies, for comparative purposes. Changes in dimensions or mix of lot sizes would yield different results.



# 3

## 68' LOT TYPICAL

Lot types with dimensions and setbacks remain constant throughout single family case studies, for comparative purposes. Changes in dimensions or mix of lot sizes would yield different results.



# 4

## GRADING PLAN

East wet pond increase in size results in a reduction of 3 lots (lot size and mix assumed consistent) and grading becomes 3:1 after 10' shoulder off road. Additional planting may be required to screen steep slopes and BMP's new visibility from road. 2:1 Dam slopes are retained and consistent with approved plan. West wet pond does not increase compared with PCCO-Central and PCCO-Western but in combination with undisturbed buffer results in 9 fewer lots. The 30' of fall to wet pond is consistent with Existing Regulations.



URBAN INFILL

CASE  
STUDIES

OVERVIEW

FACT SHEET

COST COMPARISONS

EXISTING CONDITIONS

EXISTING REGULATIONS

CASE STUDY #6 PCCO TRANSIT

CASE STUDY #7 PCCO CENTRAL-CATAWBA



The project example for the Urban Infill Analysis is an approximately 2.87 acre site located within a proposed transit station area along Charlotte's Light Rail Corridor in the South End District. The project is a redevelopment of an existing, highly impervious retail business use that will be demolished to make way for a multi-story residential building with structured parking. The residential units for this project will be offered for rent, but may be sold as condominiums in the future. The 2.87 acre parcel was purchased for \$6.5 million in August 2006. The project will propose 310 residential apartments. The project is estimated to be valued at \$75 million.

There are no known environmental features associated with the existing site, and the proposed development will reduce the impervious area associated with this parcel, thus reducing storm water runoff generated. Two case studies have been provided with this analysis. The post-construction ordinance transit station area and distressed business district provisions (PCCO-Transit) and the post-construction ordinance Central Catawba standards (PCCO-Central Catawba) will be incorporated into the design of this development to be compared with the existing regulations. Cost comparisons of site development improvements are provided. The USDG are not analyzed with this project as the existing project currently meets the standards of that ordinance. Additionally, Minimum Permit Requirements would not introduce additional storm water requirements as impervious from this project is being reduced with the proposed improvements. Therefore, no additional costs would be incurred with the implementation of USDG or Minimum Permit Requirements.

In summary, the existing project was developed with no storm water controls other than standard facilities as required to adequately drain the site's runoff. No public

drainage improvements were required. For the implementation of the PCCO- transit provisions, an underground detention facility was incorporated to meet peak flow detention and volume control requirements for the ten (10) year and one (1) year design storm events, respectively. An analysis of the down stream storm drainage system receiving the site runoff was conducted and concluded that only 10-year detention was needed. However, the receiving system was lowered to accept the project site's runoff. Minor changes to the approved utilities proposed with the approved plans were incorporated to accommodate the underground storm water system. The site development cost associated with the PCCO-Transit provisions is \$1.4 million compared to \$909,990 for the approved site (refer to cost estimate enclosed).

For the implementation of the PCCO-Central Catawba, an underground sand filter/detention system was incorporated to meet water quality, volume and peak flow detention requirements. The same downstream analysis of the receiving drainage system was brought forth from the transit corridor provisions study. Minor changes to the approved utilities were made to accommodate the underground BMP proposed with this analysis. In addition, open space as defined in the PCCO, was not required as the site was defined as redevelopment. The site development cost associated with this scenario is \$1.75 million dollars (refer to cost estimate enclosed).

Staff reviewed the project development in relation to the draft Environmental Chapter of the City of Charlotte's General Development Policies (GDP-E). Staff recognizes the high degree of existing impervious area and that applying the PCCO would improve the quality of the runoff from the existing impervious area and would serve to meet the intent of the GDP-E.

**DESIGN CRITERIA**

REQUIRED ELEMENTS	EXISTING REGULATIONS	PCCO-TRANSIT	PCCO-CENTRAL CATAWBA
PARKING	2 SPACES/UNIT-MAX	2 SPACES/UNIT-MAX	2 SPACES/UNIT-MAX
OPEN SPACE	4,350 SF	4,350 SF	4,350 SF
TREE SAVE	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
UNDISTURBED OPEN SPACE*	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
BUFFERS	N/A	PCCO	PCCO
85% TSS* REMOVAL	NOT REQUIRED	NOT REQUIRED	X
70% TP* REMOVAL	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
DETENTION	NOT REQUIRED	X	X
VOLUME ATTENUATION	NOT REQUIRED	X	X

\* See Appendix for definitions.

**DEVELOPMENT SUMMARY**

ELEMENTS	EXISTING REGULATIONS	PCCO-TRANSIT	PCCO-CENTRAL CATAWBA
ZONING	TOD-M	TOD-M	TOD-M
SITE ACREAGE	2.87	2.87	2.87
UNITS	310	310	310
DWELLING UNIT PER ACRE (DUA)	108	108	108
PRIVATE ROADS (LINEAR FEET)	N/A	N/A	N/A
% IMPERVIOUS	77.1%	77.1%	77.1%
PARKING REQUIRED (MAX)	610 (2SP/UNIT-MAX)	610 (2SP/UNIT-MAX)	610 (2SP/UNIT-MAX)
PARKING PROVIDED	515	515	515
OPEN SPACE REQUIRED**	0.10 AC	0.10 AC	0.10 AC
OPEN SPACE PROVIDED	0.12 AC	0.12 AC	0.12 AC
TREE SAVE AREA REQUIRED**	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
TREE SAVE AREA PROVIDED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
UNDISTURBED OPEN SPACE REQUIRED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
UNDISTURBED OPEN SPACE PROVIDED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
BMP**-SAND FILTER	NOT REQUIRED	NOT REQUIRED	PROVIDED
BMP**-UNDERGROUND DETENTION	NOT REQUIRED	PROVIDED	PROVIDED
OFF-SITE IMPROVEMENTS	NOT REQUIRED	PUBLIC DRAINAGE	PUBLIC DRAINAGE

\* All site design elements are applied as required to meet conditions of draft ordinances/policies based on specific conditions of site and in some cases, the original development plan. Some elements and results would change with changing site conditions or slight variations in the development plan. Items specific to the approved plan were, where possible, held constant or varied only slightly to meet draft policies.

\*\* See Appendix for definitions.



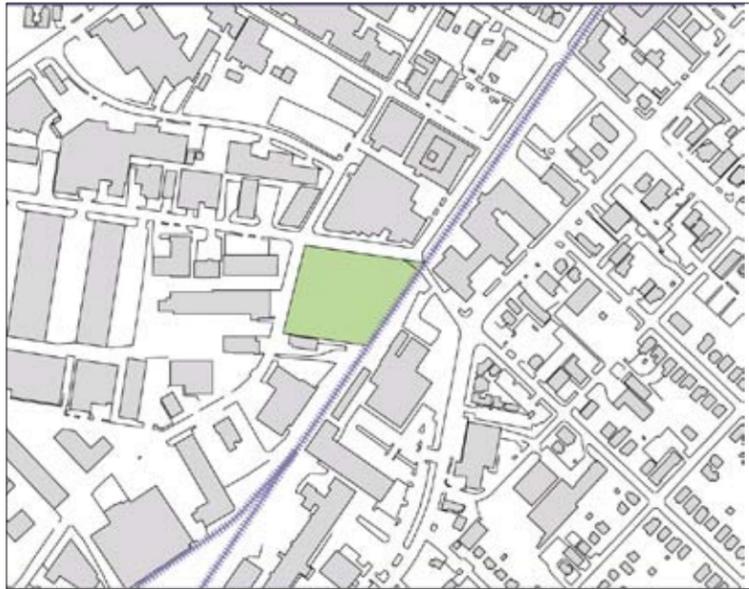
**COST ESTIMATE SUMMARY**

ELEMENTS	EXISTING REGULATIONS	PCCO-TRANSIT	PCCO-CENTRAL CATAWBA
ALLOWANCES	\$100,300	\$100,300	\$100,300
SITE GRADING	\$70,300	\$70,300	\$70,300
STORM DRAINAGE	\$65,000	\$33,800	\$53,800
WATER & SANITARY SEWER	\$63,600	\$63,600	\$63,600
EROSION CONTROL	\$12,800	\$12,800	\$12,800
ROOF DRAINS	\$37,000	\$34,900	\$34,900
HARDSCAPE	\$500,700	\$500,700	\$500,700
LANDSCAPE	\$60,200	\$60,200	\$60,200
UNDERGROUND DETENTION*	-	\$508,300	-
SAND FILTER/DETENTION**	-	-	\$885,100
<b>TOTAL</b>	<b>\$910,000</b>	<b>\$1,385,000</b>	<b>\$1,751,800</b>

\* Peak flow and volume detention provided.

\*\* Water Quality (85% TSS), peak flow and volume detention provided.

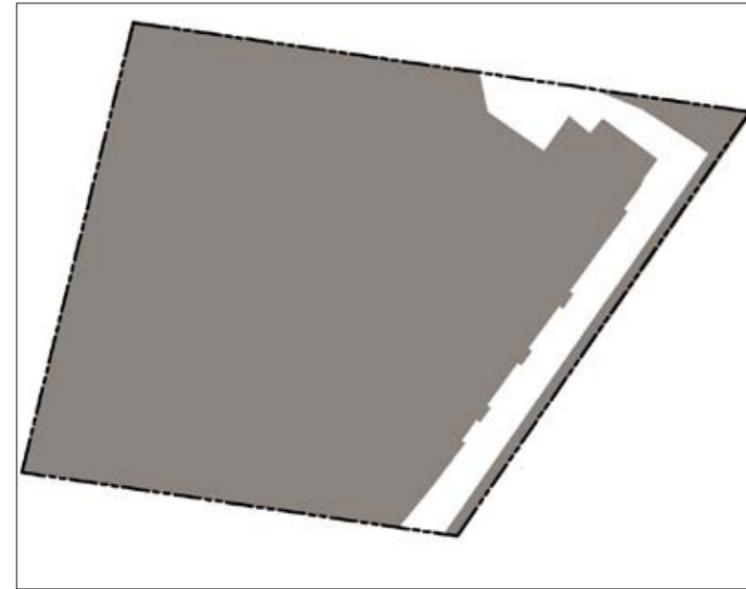
Note: 1. Minimum Permit Requirements - Project exempt due to decrease in impervious area with redevelopment.  
2. Project exempt from open space requirements as defined in PCCO due to redevelopment designation.



# 1

## CONTEXT MAP

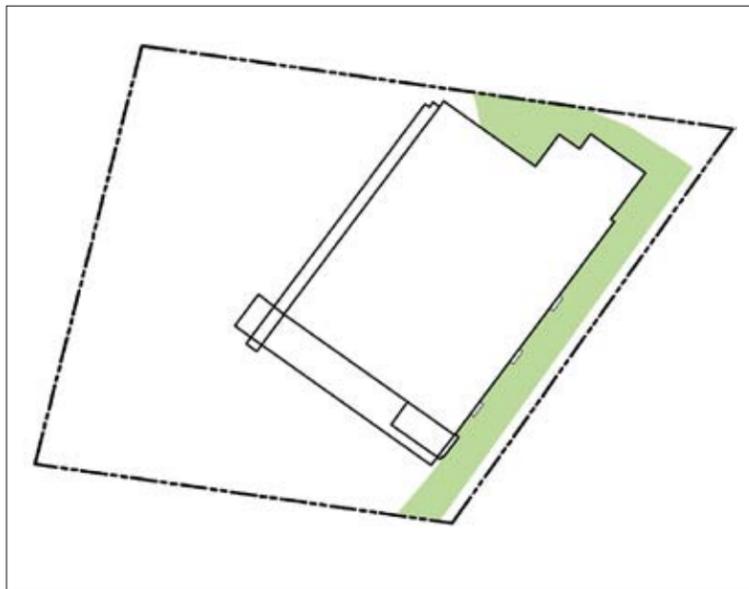
The site is located in an urban area along a proposed transit line within a 5 minute walk from a proposed transit station. The site is within a district that has a large number of completed and proposed infill projects.



# 3

## IMPERVIOUS

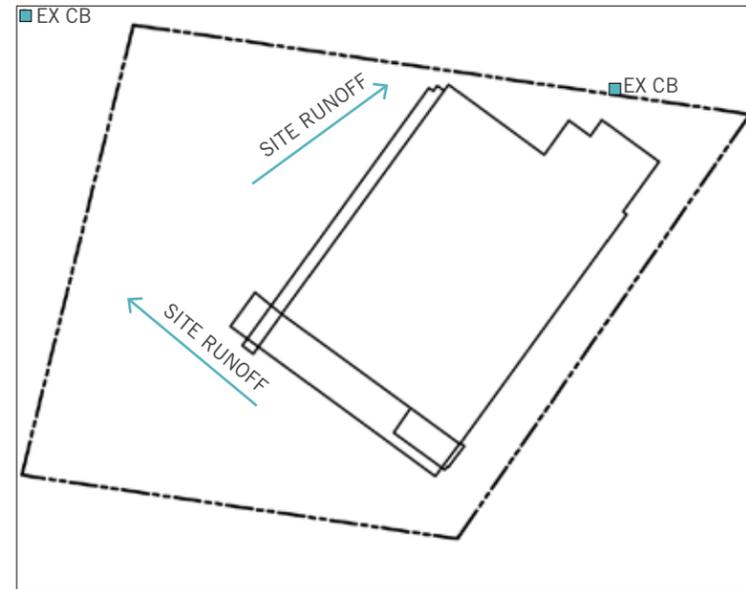
Over 87% of the existing site conditions was impervious.



# 2

## OPEN SPACE

The existing open space area was 0.35 AC (12.2%). The open space area consisted of highly maintained shrubs and lawn. Fewer than 5 trees existed on site, and none of the existing open space could be counted as undisturbed open space as defined in the Post Construction Controls Ordinance.



# 4

## STORM WATER MANAGEMENT

Existing conditions did not provide on-site detention or water quality. Storm water management consisted of building and parking lot runoff flowing off-site to nearest storm drainage within public right-of-way.



### DEVELOPMENT SUMMARY

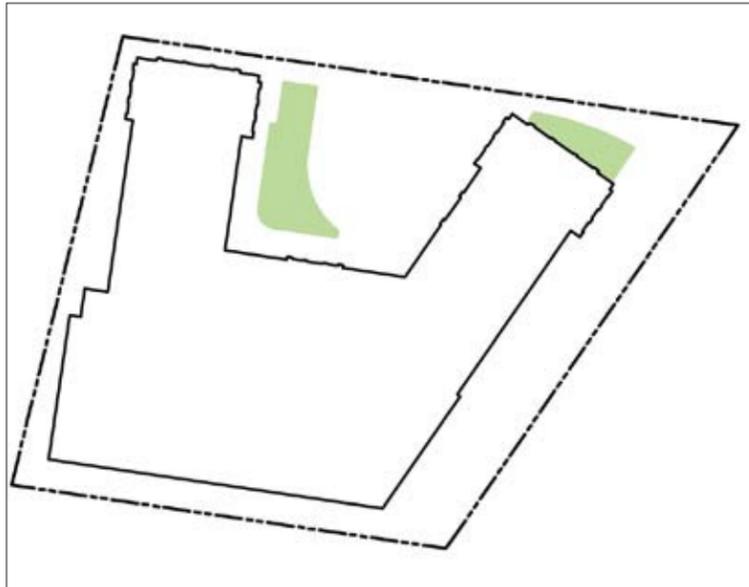
- ZONING: TOD-M
- TOTAL PARCEL (AC): 2.87
- UNITS: 1 WAREHOUSE / SHOWROOM
- DUA: 0.35
- STREETS, PRIVATE (LF): N/A
- PERCENT IMPERVIOUS: 87.8%
- PARKING REQUIRED: N/A
- PARKING PROVIDED: +/- 50 SPACES
- OPEN SPACE REQUIRED (AC): N/A
- OPEN SPACE PROVIDED (AC): 0.28 AC
- TREE SAVE REQUIRED (AC): N/A
- TREE SAVE PROVIDED (AC): N/A
- UNDISTURBED OPEN SPACE REQUIRED (AC): N/A
- UNDISTURBED OPEN SPACE PROVIDED (AC): N/A
- BMP - SAND FILTER: NOT REQUIRED
- BMP - UNDERGROUND DETENTION: NOT REQUIRED
- OFF-SITE IMPROVEMENTS: NOT REQUIRED

### COST ESTIMATE SUMMARY

- N/A
- N/A
- N/A
- N/A
- N/A

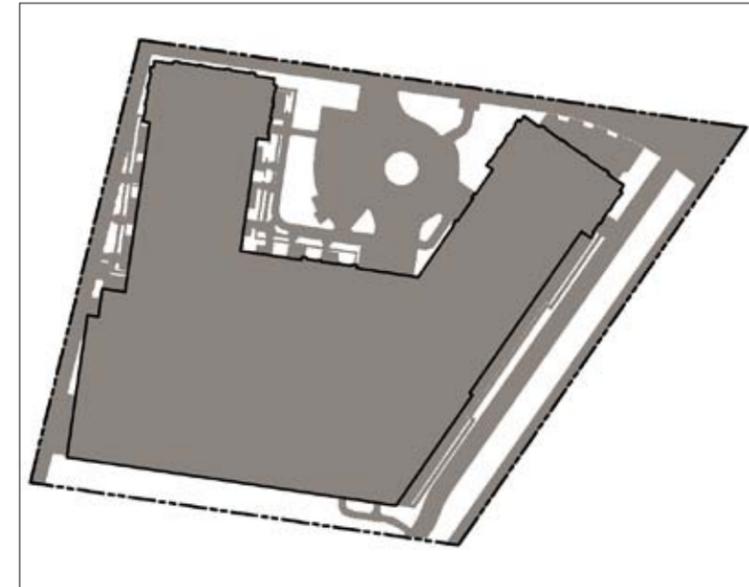
### NOTES

The existing conditions had several important elements to note. First, the site was 87.8% impervious with less than 5 existing trees. The high level of existing impervious allowed the proposed development to provide a highly impervious infill development without additional storm water management features and without increasing storm water runoff. Secondly, 0.55 AC (19%) of the site was within a rail right-of-way. The proposed transit development required the developer to maximize the buildable area due to undevelopable land within the transit right-of-way.



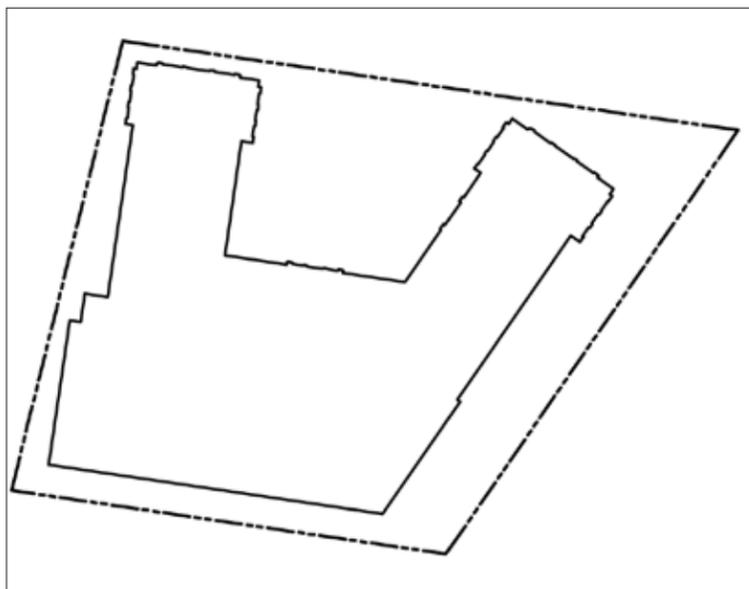
**1**  
**OPEN SPACE**

The rezoning plan required 0.1 AC of open space. A majority of the 0.1 AC open space provided is impervious hardscape. Current zoning gives credit to improved areas for active or passive recreation although the area has been disturbed and/or is impervious.



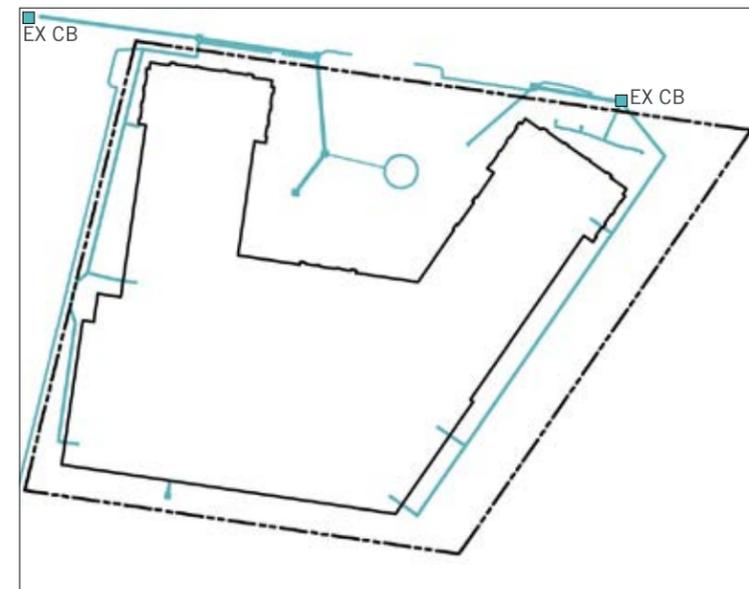
**3**  
**IMPERVIOUS**

The approved plan is a slight reduction in impervious surface compared with existing conditions. Impervious area is around 77%. Building footprint itself occupies 53% of the site.



**2**  
**UNDISTURBED OPEN SPACE**

The existing conditions did not provide any area that could be claimed as undisturbed open space. Since undisturbed open space was not required under the current zoning, the approved plan did not provide undisturbed open space.



**4**  
**STORM WATER MANAGEMENT**

No water quality or storm water detention improvements were required for the Existing Regulations. Storm water was piped untreated into the existing adjacent storm water collection facilities.



### DEVELOPMENT SUMMARY

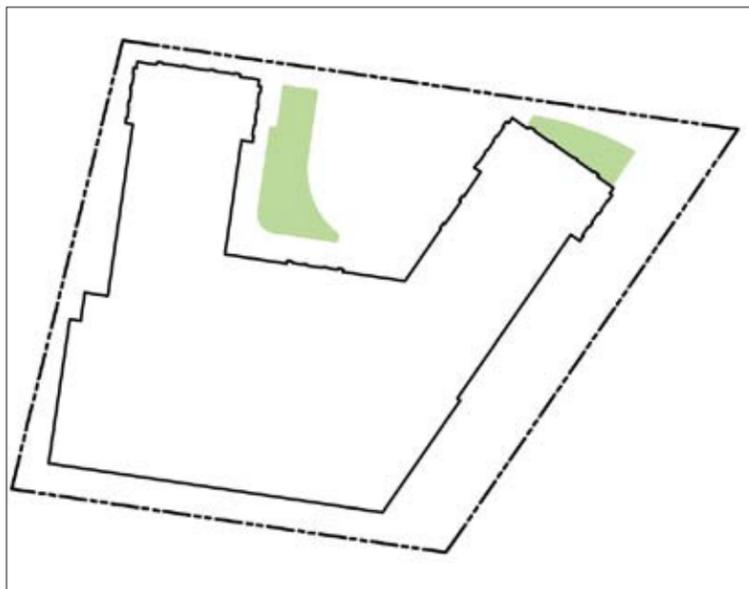
- ZONING: TOD-M
- TOTAL PARCEL (AC): 2.87
- UNITS: 310
- DUA: 108
- STREETS, PRIVATE (LF): N/A
- PERCENT IMPERVIOUS: 77.1%
- PARKING REQUIRED: 2SP/UNIT MAX
- PARKING PROVIDED: 515
- OPEN SPACE REQUIRED (AC): 0.10
- OPEN SPACE PROVIDED (AC): 0.12
- TREE SAVE REQUIRED (AC): NOT REQUIRED
- TREE SAVE PROVIDED (AC): NOT REQUIRED
- UNDISTURBED OPEN SPACE REQUIRED (AC): N/R
- UNDISTURBED OPEN SPACE PROVIDED (AC): N/R
- BMP - SAND FILTER: N/R
- BMP - UNDERGROUND DETENTION: N/R
- OFF-SITE IMPROVEMENTS: N/R

### COST ESTIMATE SUMMARY

- ALLOWANCES: \$100,300
- SITE GRADING: \$70,300
- STORM DRAINAGE: \$65,000
- WATER AND SANITARY SEWER: \$63,600
- EROSION CONTROL: \$12,800
- ROOF DRAINS: \$34,000
- HARDSCAPE: \$500,700
- LANDSCAPE: \$60,200
- **TOTAL: \$910,000**

### NOTES

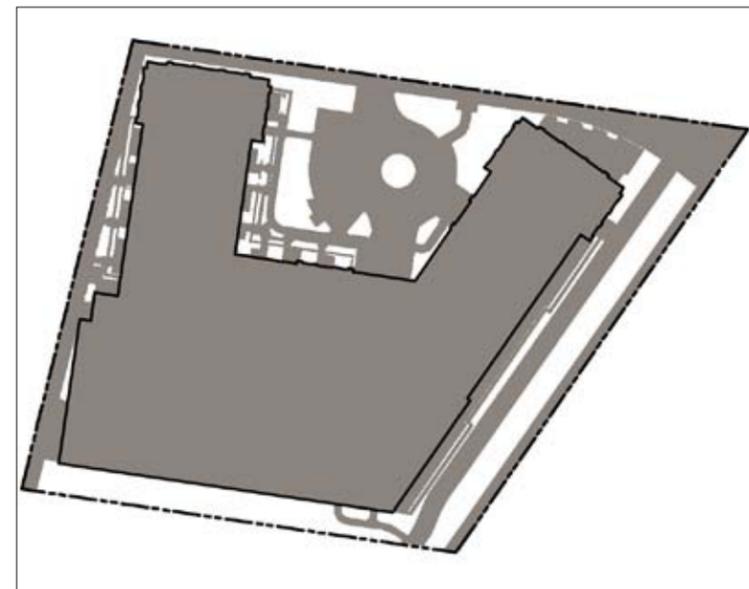
A highly impervious infill project with a slight reduction of impervious area and thus a reduction of storm water runoff. No water quality or quantity BMPs were incorporated into the Existing Regulations.



# 1

## OPEN SPACE

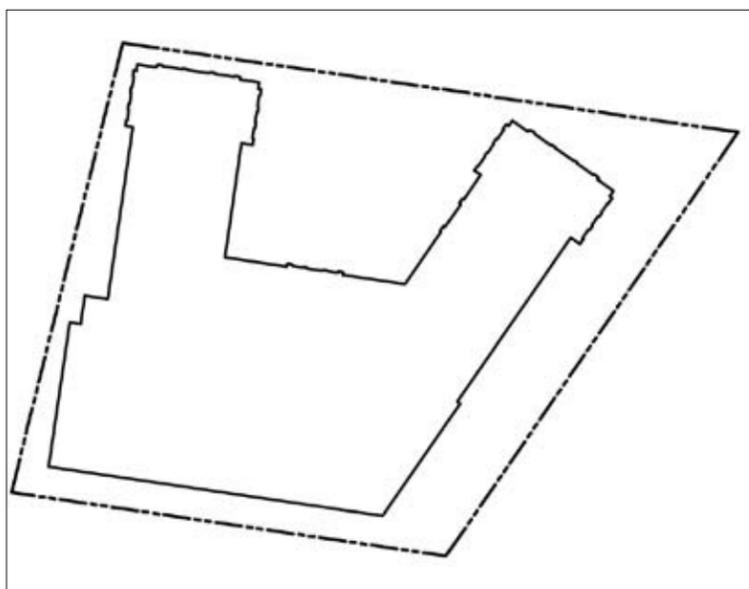
PCCO - Transit did not require additional open space compared with the Existing Regulations. The same 0.1 AC of open space required in the rezoning plan is provided in the PCCO - Transit.



# 3

## IMPERVIOUS

The PCCO - Transit impervious area is approximately 77.1%. The PCCO - Transit design does not change the impervious area when compared with the Existing Regulations.



# 2

## UNDISTURBED OPEN SPACE

Special provisions within the PCCO-Transit ordinance allow development to forego the undisturbed open space requirements.



# 4

## STORM WATER MANAGEMENT

Special provisions within the PCCO - Transit requirements allow development to forego water quality requirements. Underground detention and volume control were provided per ordinance. Off-site drainage improvements were required to receive the site drainage at a lower invert.



### DEVELOPMENT SUMMARY

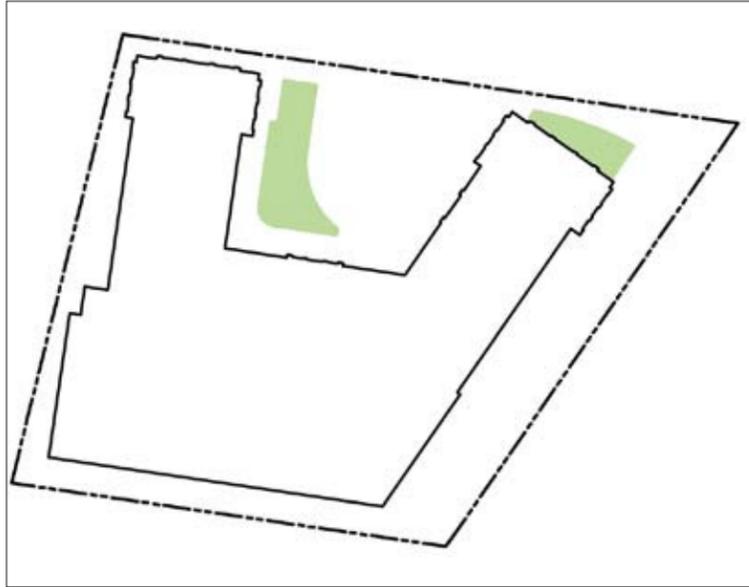
- ZONING: TOD-M
- TOTAL PARCEL (AC): 2.87
- UNITS: 310
- DUA: 108
- STREETS, PRIVATE (LF): N/A
- PERCENT IMPERVIOUS: 77.1%
- PARKING REQUIRED: 2 SPACES/ UNIT MAX
- PARKING PROVIDED: 515
- OPEN SPACE REQUIRED (AC): 0.10
- OPEN SPACE PROVIDED (AC): 0.12
- TREE SAVE REQUIRED (AC): N/R
- TREE SAVE PROVIDED (AC): N/R
- UNDISTURBED OPEN SPACE REQUIRED (AC): N/R
- UNDISTURBED OPEN SPACE PROVIDED (AC): N/R
- BMP - SAND FILTER: NOT REQUIRED
- BMP - UNDERGROUND DETENTION: PROVIDED
- OFF-SITE IMPROVEMENTS: PROVIDED

### COST ESTIMATE SUMMARY

- ALLOWANCES: \$100,300
- SITE GRADING: \$70,300
- STORM DRAINAGE: \$33,800
- WATER AND SANITARY SEWER: \$63,600
- EROSION CONTROL: \$12,800
- ROOF DRAINS: \$34,900
- HARDSCAPE: \$500,700
- LANDSCAPE: \$60,200
- UNDERGROUND DETENTION: \$508,300
- **TOTAL: \$1,385,000**

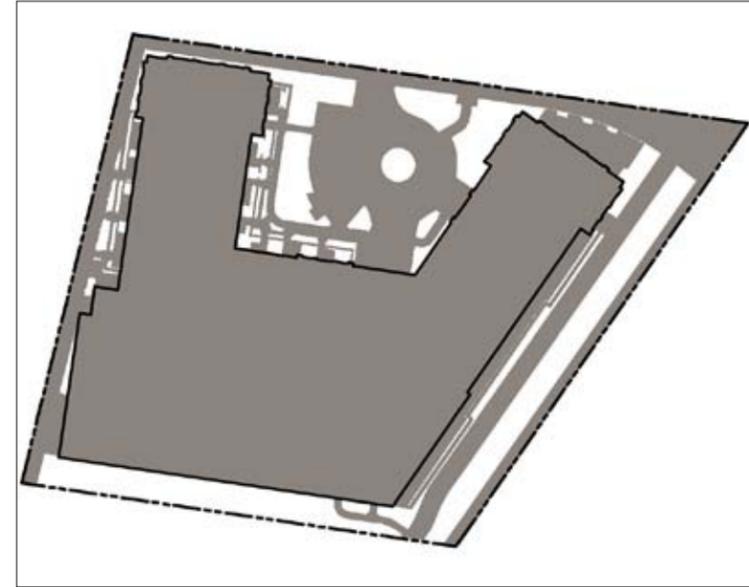
### NOTES

Detention provided with standard underground metal pipe system. Spatial constraints required an underground BMP to meet this requirement. USDG requirements were satisfied with streetscape proposed with Existing Regulations.



# 1 OPEN SPACE

PCCO - Central did not require additional open space compared with the Existing Regulations. The same 0.1 AC of open space required in the rezoning plan is provided in the PCCO - Central.



# 3 IMPERVIOUS

The PCCO - Central impervious area is approximately 77.1%. The PCCO - Central design does not change the impervious area when compared with the Existing Regulations.



# 2 UNDISTURBED OPEN SPACE

The PCCO-Central plan did not require undisturbed open space because the site is defined as a redevelopment.



# 4 STORM WATER MANAGEMENT

The PCCO-Central required detention and storm water treatment. A sand filter combined with underground detention was used to meet (PCCO - Central) requirements. Off-site drainage improvements were required to receive the site drainage at a lower invert.

## CASE STUDY #7 PCCO CENTRAL CATAWBA



### DEVELOPMENT SUMMARY

- ZONING: TOD-M
- TOTAL PARCEL (AC): 2.87
- UNITS: 310
- DUA: 108
- STREETS, PRIVATE (LF): N/A
- PERCENT IMPERVIOUS: 77.1%
- PARKING REQUIRED: 2 SPACES/UNIT MAX
- PARKING PROVIDED: 515
- OPEN SPACE REQUIRED (AC): 0.10
- OPEN SPACE PROVIDED (AC): 0.12
- TREE SAVE REQUIRED (AC): N/R
- TREE SAVE PROVIDED (AC): N/R
- UNDISTURBED OPEN SPACE REQUIRED (AC): N/R
- UNDISTURBED OPEN SPACE PROVIDED (AC): 0
- BMP - SAND FILTER: PROVIDED
- BMP - UNDERGROUND DETENTION: PROVIDED
- OFF-SITE IMPROVEMENTS: PROVIDED

### COST ESTIMATE SUMMARY

- ALLOWANCES: \$100,300
- SITE GRADING: \$70,300
- STORM DRAINAGE: \$53,800
- WATER AND SANITARY SEWER: \$63,600
- EROSION CONTROL: \$12,800
- ROOF DRAINS: \$34,900
- HARDSCAPE: \$500,700
- LANDSCAPE PLAN: \$60,200
- SAND FILTER: \$855,100
- **TOTAL: \$1,752,000**

### NOTES

Water quality and detention requirement were satisfied with cast-in-place underground concrete vault. Spatial constraints required subsurface BMP. USDG requirements were satisfied with streetscape proposed by Existing Regulations.



CASE  
STUDIES

MULTI-FAMILY  
RESIDENTIAL

OVERVIEW

FACT SHEET

COST SUMMARY ESTIMATE

EXISTING CONDITIONS

EXISTING REQUIREMENTS

CASE STUDY #8 PCCO-CENTRAL CATAWBA



The project example for the multi-family analysis is an approximately 6-acre site located on a wooded parcel bounded on three sides by existing development with no opportunity for external roadway connectivity. The site is not encumbered by floodplain, wetlands, or S.W.I.M. buffer requirements, nor is it within a watershed overlay district. Planned use of the site is for-sale townhomes with associated access and parking.

One case study is provided with this analysis. The Post Construction Controls Ordinance-Central Catawba requirements are incorporated into the desired program for this project to be compared with the regulations incorporated through the original approval process. A cost comparison of site development improvements is provided. The USDGs are not analyzed with this project as current improvements meet the standards of that ordinance. Minimum Permit Requirements are also not analyzed singularly as the PCCO-Central requirements introduce only slight additional measures, namely an increase in undisturbed open space.

In summary, the existing project adhered to current detention requirements by use of above-ground, dry detention facilities centrally located on site. Water quality

and volume control is not provided with the approved, constructed site. For the implementation of the PCCO-Central Catawba provisions, bioretention facilities were incorporated into the project storm water management to provide for water quality treatment, while above ground, dry detention facilities were maintained for the peak flow detention and volume attenuation requirements. A retaining wall was incorporated into the site design to maximize project yield. An off-site drainage analysis was performed, and the elimination of the 25-year detention requirement was realized for a portion of the site. Undisturbed open space requirements were provided for on-site by mitigated landscape areas allowed for by ordinance. The site development cost associated with the PCCO-Central Catawba provisions is \$1.52 million compared to \$1.28 million for the approved site, refer to cost estimates enclosed.

Staff reviewed the project development in relation to the draft Environmental Chapter of the City of Charlotte's General Development Policies (GDP-E). The combination of undisturbed open space, mitigated open space and water quality protection provided by the PCCO would serve to meet the intent of the GDP-E.

## DESIGN CRITERIA

ELEMENTS	EXISTING REGULATIONS	PCCO - CENTRAL CATAWBA
PARKING	1.5 SP/UNIT	1.5 SP/UNIT
EXTERNAL CONNECTIONS	1 DRIVEWAY	1 DRIVEWAY
BIKE / PEDESTRIAN CROSSING	N/A	N/A
OPEN SPACE*	3.08 AC (50%)	3.08 AC (50%)
TREE SAVE*	NOT REQUIRED	NOT REQUIRED
UNDISTURBED OPEN SPACE*	NOT REQUIRED	1.08 (17.5%)
BUFFERS	NOT REQUIRED	PCCO
85% TSS REMOVAL*	NOT REQUIRED	X
70% TP REMOVAL*	NOT REQUIRED	NOT REQUIRED
DETENTION	X	X
VOLUME CONTROL	NOT REQUIRED	X

\* See Appendix for definitions.

## DEVELOPMENT SUMMARY

ELEMENTS	EXISTING REGULATIONS	PCCO - CENTRAL CATAWBA
ZONING	R-8MF-CD	R-8MF-CD
SITE ACREAGE	6.16	6.16
UNITS	44	40
DWELLING UNIT PER ACRE (DUA)**	7.14	6.49
PRIVATE ROADS (LINEAR FEET)**	2,813	2,538
% IMPERVIOUS	49%	42.1%
PARKING REQUIRED**	66 (1.5 SP/UNIT)	60 (1.5 SP/UNIT)
PARKING PROVIDED	113	95
OPEN SPACE REQUIRED**	50%	50%
OPEN SPACE PROVIDED	3.14 AC (51%)	3.57 AC (57.9%)
TREE SAVE AREA REQUIRED**	NOT REQUIRED	NOT REQUIRED
TREE SAVE AREA PROVIDED	0.77 AC	0.77 AC
UNDISTURBED OPEN SPACE REQUIRED**	NOT REQUIRED	1.08 AC (17.5%)
UNDISTURBED OPEN SPACE PROVIDED	NOT REQUIRED	0.77 AC
MITIGATED UNDISTURBED OPEN SPACE	NOT REQUIRED	0.47 AC
BMP** - DRY DETENTION	YES	YES
BMP** - BIORETENTION	NOT REQUIRED	YES
OFF-SITE IMPROVEMENTS	YES***	YES***

\* All site design elements are applied as required to meet conditions of draft ordinance/ordinances based on specific conditions of site and are subject to change with changing site conditions.

\*\* See Appendix for definitions.

\*\*\* Drainage pipe under Elm Lane.



**COST ESTIMATE SUMMARY**

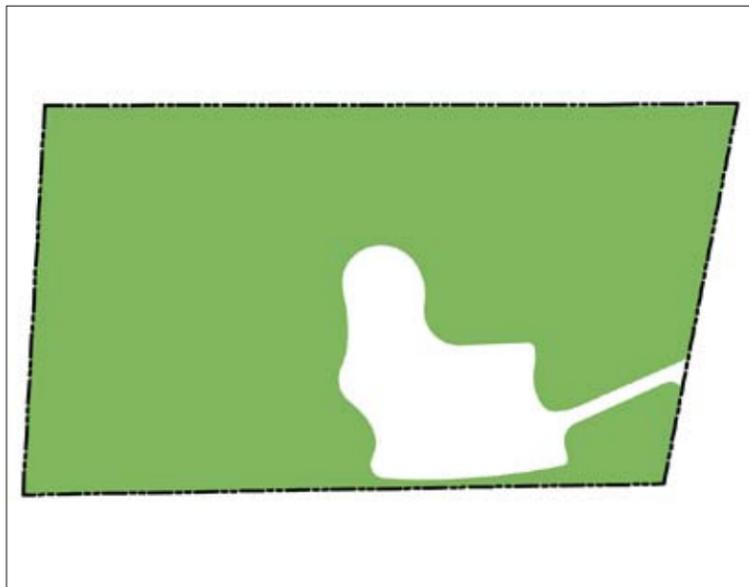
ELEMENTS	EXISTING REGULATIONS	PCCO-CENTRAL CATAWBA
ALLOWANCES	\$70,300	\$70,300
SITE GRADING	\$208,900	\$182,200
STORM DRAINAGE	\$237,700	\$444,200
WATER & SANITARY SEWER	\$300,200	\$300,200
EROSION CONTROL PHASE I	\$22,000	\$22,000
EROSION CONTROL PHASE II	\$16,100	\$16,100
STREETS (PAVING)	\$187,700	\$178,000
LANDSCAPE	\$232,700	\$301,300
OPEN SPACE MITIGATION	N/R	\$8,600
<b>TOTAL</b>	<b>\$1,275,700</b>	<b>\$1,523,000</b>



# 1

## CONTEXT MAP

The site is located along a boulevard adjacent to single-family residential and multi-family residential development. A large commercial development is west of the site.



# 2

## EXISTING TREE COVER

Around 85% of the site has existing tree canopy except for the house driveway and lawn areas.



### DEVELOPMENT SUMMARY

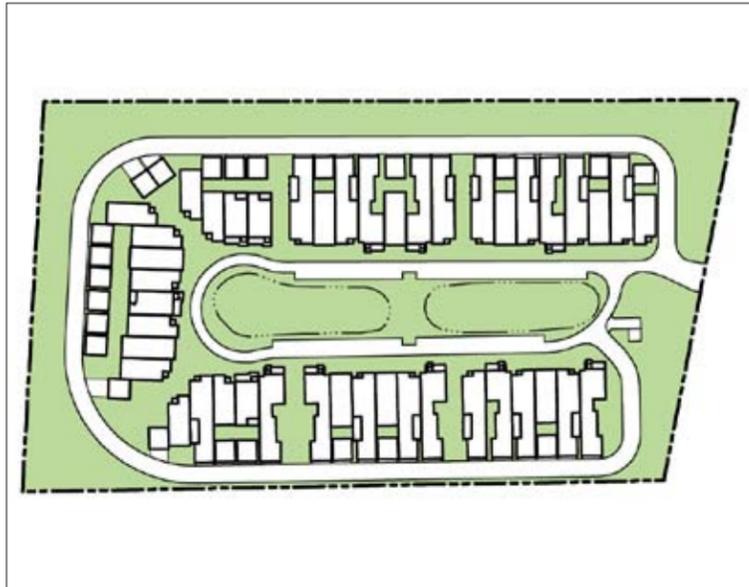
- ❑ ZONING: N/R
- ❑ SITE ACREAGE (AC): 6.16
- ❑ UNITS: 1 SINGLE FAMILY RESIDENTIAL
- ❑ DUA: 0.16
- ❑ PRIVATE ROADS (LF): 0
- ❑ PERCENT IMPERVIOUS: 4%
- ❑ PARKING REQUIRED: N/R
- ❑ PARKING PROVIDED: N/R
- ❑ OPEN SPACE REQUIRED (AC): N/R
- ❑ OPEN SPACE PROVIDED (AC): N/R
- ❑ TREE SAVE REQUIRED (AC): N/R
- ❑ TREE SAVE PROVIDED (AC): 75-80%
- ❑ UNDISTURBED OPEN SPACE REQUIRED (AC): N/R
- ❑ UNDISTURBED OPEN SPACE PROVIDED (AC): N/R
- ❑ MITIGATED UNDISTURBED OPEN SPACE (AC): N/R
- ❑ BMP - DRY DETENTION: N/R
- ❑ BMP - BIORETENTION: N/R
- ❑ OFF-SITE IMPROVEMENTS: N/R

### COST ESTIMATE SUMMARY

- ❑ N/R

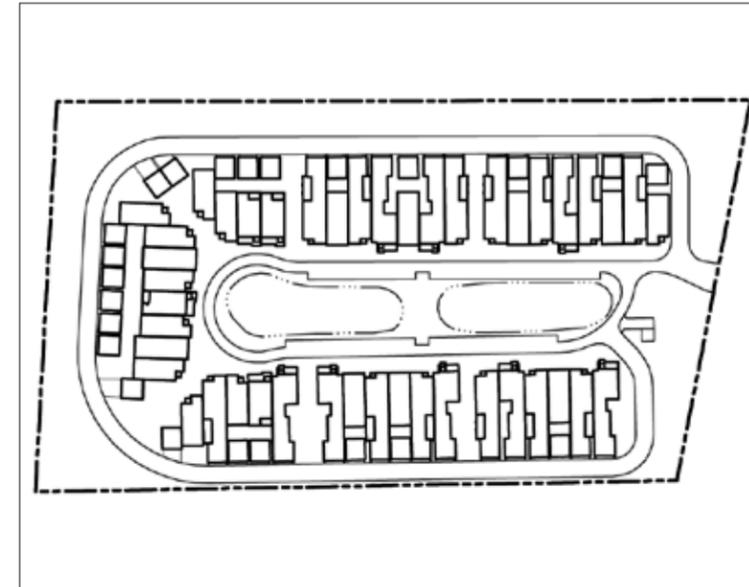
### NOTES

Prior to development the project site housed one single family residence. The parcel was heavily vegetated and contributed minimal to zero negative impact stemming from its site runoff.



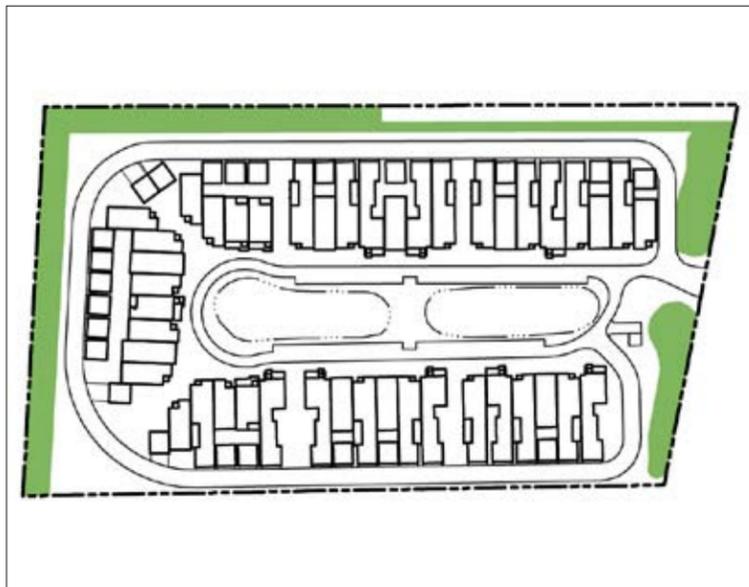
# 1 OPEN SPACE

Total open space provided is 3.14 AC (51%). 50% open space was required for R-8 MF-CD Zoning. Current zoning gives open space credit for improved areas for active or passive recreation, although the area has been disturbed or is impervious.



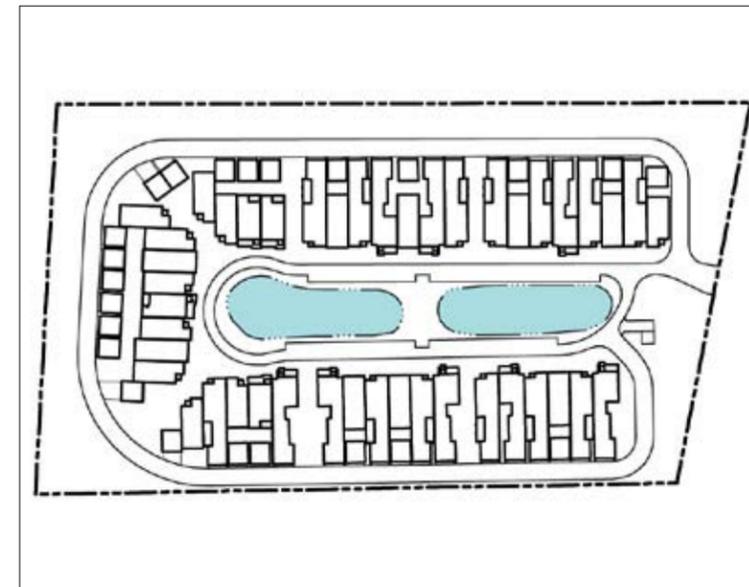
# 3 UNDISTURBED OPEN SPACE ON-SITE MITIGATION

No undisturbed open space on-site mitigation was required.



# 2 UNDISTURBED OPEN SPACE

Undisturbed open space was not required under current zoning. However the Existing Regulations provided 0.77 AC of undisturbed open space.



# 4 BMP - DRY DETENTION

Only peak flow detention was required of the approved development to meet current storm water standards. The 2-year and 10-year storm events were detained in at-grade, dry detention facilities centrally located on site to meet pre-developed release rates.



### DEVELOPMENT SUMMARY

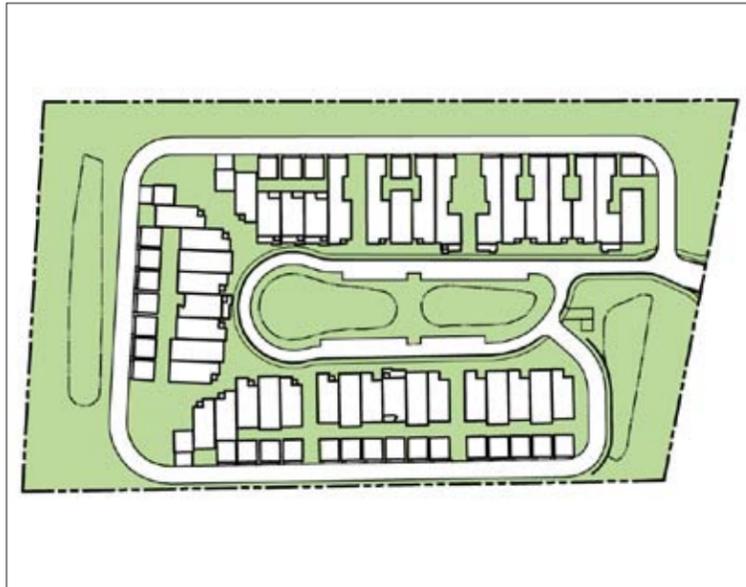
- ❑ ZONING: R-8 MF-CD
- ❑ SITE ACREAGE (AC): 6.16
- ❑ UNITS: 44
- ❑ DUA: 7.14
- ❑ PRIVATE ROADS (LF): 2.813
- ❑ PERCENT IMPERVIOUS: 49%
- ❑ PARKING REQUIRED: 66 (1.5 SPACE/UNIT)
- ❑ PARKING PROVIDED: 113
- ❑ OPEN SPACE REQUIRED (AC): 3.08 (50%)
- ❑ OPEN SPACE PROVIDED (AC): 3.14 (51%)
- ❑ TREE SAVE REQUIRED (AC): N/R
- ❑ TREE SAVE PROVIDED (AC): 0.77 (12.5%)
- ❑ UNDISTURBED OPEN SPACE REQUIRED (AC): N/R
- ❑ UNDISTURBED OPEN SPACE PROVIDED (AC): 0.77
- ❑ MITIGATED UNDISTURBED OPEN SPACE (AC): N/R
- ❑ BMP - DRY DETENTION: YES
- ❑ BMP - BIORETENTION: N/R
- ❑ OFF-SITE IMPROVEMENTS: YES

### COST ESTIMATE SUMMARY

- ❑ ALLOWANCES: \$70,300
- ❑ SITE GRADING: \$209,000
- ❑ STORM DRAINAGE: \$237,700
- ❑ WATER & SANITARY SEWER: \$300,200
- ❑ EROSION CONTROL PHASE I: \$22,038.64
- ❑ EROSION CONTROL PHASE II: \$16,100
- ❑ STREETS (PAVING): \$187,700
- ❑ LANDSCAPE: \$232,700
- ❑ OPEN SPACE MITIGATION: N/R
- ❑ **TOTAL: \$1,275,700**

### NOTES

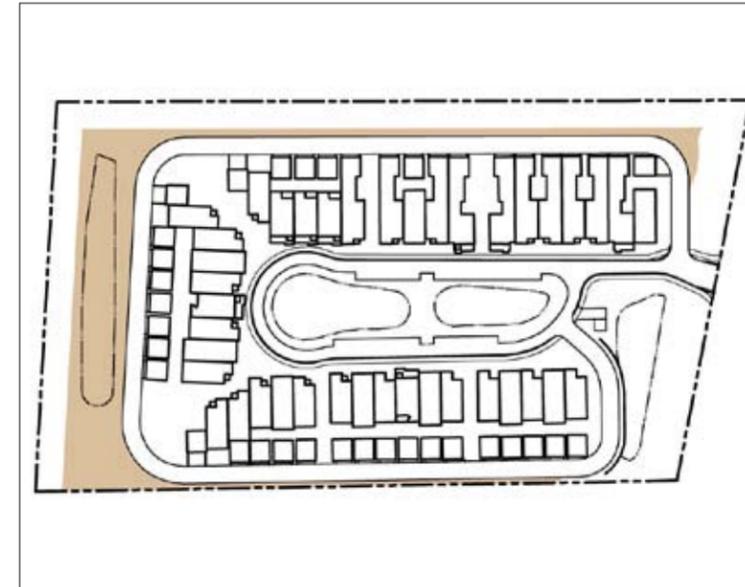
The project was mass graded to provide for 44 attached townhome units. Dry detention was provided on-site to meet existing detention regulations. No water quality standards were a condition of site approval.



# 1

## OPEN SPACE

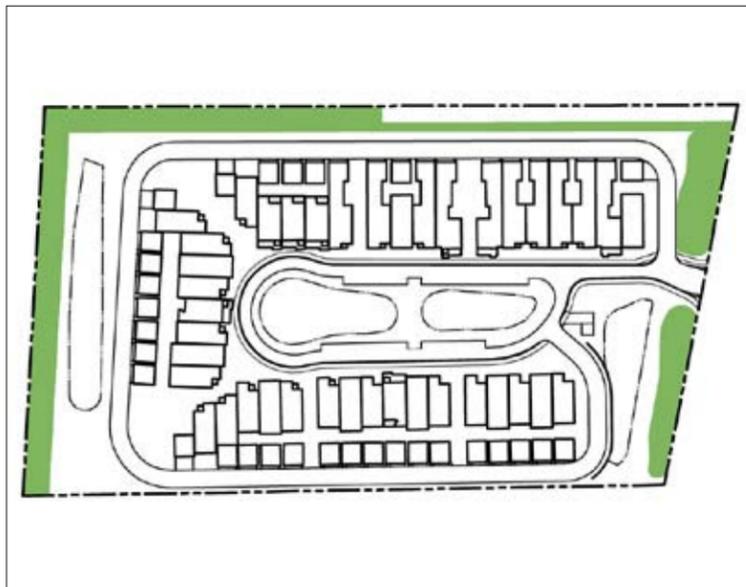
Total open space provided is 3.62 AC (58%). The amount of open space increased 0.5 acre compared with the Existing Regulations to provide for additional BMP area.



# 3

## UNDISTURBED OPEN SPACE ON-SITE MITIGATION

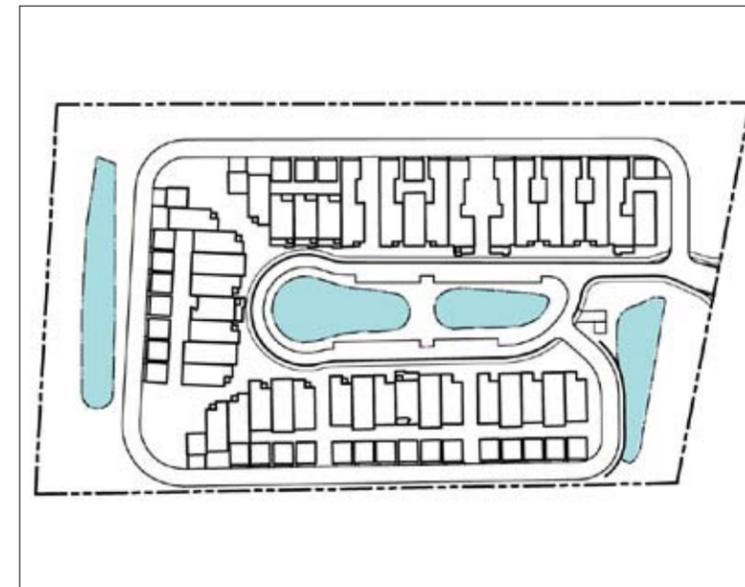
0.44 AC of on-site mitigation is required to meet undisturbed open space requirements. On-site mitigation is provided at a rate of 150% in areas that will not be disturbed in the future



# 2

## UNDISTURBED OPEN SPACE

Total undisturbed open space provided is 0.77 AC. The PPCO-Central Plan was unable to provide all required open space without a large reduction in units. All undisturbed open space was found in buffers.



# 4

## BMP - DRY DETENTION AND BIORETENTION

Bioretention facilities were incorporated into the storm water management for the project to provide for water quality treatment. Above ground, dry detention was maintained to provide for peak flow and volume control .



### DEVELOPMENT SUMMARY

- ❑ ZONING: R-8 MF-CD
- ❑ SITE ACREAGE (AC): 6.16
- ❑ UNITS: 40
- ❑ DUA: 6.49
- ❑ PRIVATE ROADS (LF): 2,538
- ❑ PERCENT IMPERVIOUS: 42.1%
- ❑ PARKING REQUIRED: 60 (1.5 SPACE/UNIT)
- ❑ PARKING PROVIDED: 95
- ❑ OPEN SPACE REQUIRED (AC): 3.08 (50%)
- ❑ OPEN SPACE PROVIDED (AC): 3.57 (57.9%)
- ❑ TREE SAVE REQUIRED (AC): N/R
- ❑ TREE SAVE PROVIDED (AC): 0.77 (12.5%)
- ❑ UNDISTURBED OPEN SPACE REQUIRED (AC): 1.08 (17.5%)
- ❑ UNDISTURBED OPEN SPACE PROVIDED (AC): 0.77 (12.5%)
- ❑ MITIGATED UNDISTURBED OPEN SPACE (AC): 0.47
- ❑ BMP - DRY DETENTION: YES
- ❑ BMP - BIORETENTION: YES
- ❑ OFF-SITE IMPROVEMENTS: YES

### COST ESTIMATE SUMMARY

- ❑ ALLOWANCES: \$70,300
- ❑ SITE GRADING: \$182,200
- ❑ STORM DRAINAGE: \$444,200
- ❑ WATER & SANITARY SEWER: \$300,200
- ❑ EROSION CONTROL PHASE I: \$22,000
- ❑ EROSION CONTROL PHASE II: \$16,100
- ❑ STREETS (PAVING): \$177,900
- ❑ LANDSCAPE: \$301,300
- ❑ OPEN SPACE MITIGATION: \$8,600
- ❑ **TOTAL: \$1,523,000**

### NOTES

This analysis realized a 4-unit decrease in townhome units as required to incorporate BMPs sufficient to meet water quality standards. USDG were not analyzed as the Existing Regulations provides streetscape in conformance with USDA standards.



COMMERCIAL

CASE  
STUDIES

OVERVIEW

FACT SHEET

COST SUMMARY ESTIMATE

EXISTING CONDITIONS

EXISTING REGULATIONS

CASE STUDY #9 MINIMUM PERMIT REQUIREMENTS

CASE STUDY #10 PCCO-CENTRAL CATAWBA



The project example for the commercial (high impervious) program is an approximately 9.7-acre site bounded on two sides by public right-of-ways. The site is not encumbered by floodplain, wetlands (assumed), or buffer requirements nor is it within a watershed overlay district. Planned use of the site is office, retail and restaurants with associated drives and parking. Two case studies are provided with this analysis. The Minimum Permit Requirements and PCCO-Central Catawba District standards will be incorporated into the development program for the project. Changes to development costs will be compared to the estimated development cost of the Existing Regulations.

In summary, the project had to abide by detention requirements of the Existing Regulations. No water quality measures were required nor were there additional volume requirements beyond that provided with the peak flow detention of the original design. The Existing Requirements incorporated underground detention storage and wet ponds for storm water management. To meet storm water management requirements of both the PCCO and Minimum

Permit Requirements the underground detention facilities were removed from the design and above-ground wet ponds were introduced. Retaining walls were incorporated into the design of the wet ponds to minimize parking loss and maintain leasable square footage. To this end, relative costs were kept fairly consistent with those of the Existing Regulations. However, open space requirements of the PCCO required an off-site mitigation option to be utilized, resulting in a significant payout to mitigate open space.

The site development costs associated with the Minimum Permit Requirements analysis are \$3,061,600 compared to \$3,109,600 for the Existing Regulations. The site development costs for the PCCO-Central Catawba analysis are \$3,453,000. Refer to the cost estimate figures enclosed.

Staff reviewed the project development in relation to the draft Environmental Chapter of the City of Charlotte's General Development Policies (GDP-E). The combination of undisturbed open space, mitigated open space and water quality protection provided by the PCCO would serve to meet the intent of the GDP-E.

**DESIGN CRITERIA**

REQUIRED ELEMENTS	EXISTING REGULATIONS	MINIMUM PERMIT REQUIREMENTS	PCCO-CENTRAL CATAWBA
PARKING	167	167	167
EXTERNAL CONNECTIONS	4	4	4
OPEN SPACE	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
TREE SAVE	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
UNDISTURBED OPEN SPACE	NOT REQUIRED	NOT REQUIRED	10%
BUFFERS	N/A	N/A	N/A
85% TSS REMOVAL*	NOT REQUIRED	NOT REQUIRED	X
70% TP REMOVAL*	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
DETENTION	X	X	X
VOLUME CONTROL	X	X	X

\* See Appendix for definitions.

**DEVELOPMENT SUMMARY**

ELEMENTS	EXISTING REGULATIONS	MINIMUM PERMIT REQUIREMENTS	PCCO-CENTRAL CATAWBA
ZONING	NS	NS	NS
SITE ACREAGE	9.66	9.66	9.66
BUILDING (SQUARE FEET)	99,829 SF	99,829 SF	99,829 SF
PRIVATE ROADS (LINEAR FEET)	N/A	N/A	N/A
% IMPERVIOUS	83%	83%	83%
PARKING REQUIRED	167	167	167
PARKING PROVIDED	404	362	359
OPEN SPACE REQUIRED**	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
OPEN SPACE PROVIDED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
TREE SAVE AREA REQUIRED**	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
TREE SAVE AREA PROVIDED	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED
UNDISTURBED OPEN SPACE REQUIRED**	NOT REQUIRED	NOT REQUIRED	0.97 (10%)
UNDISTURBED OPEN SPACE PROVIDED	NOT REQUIRED	NOT REQUIRED	0.16 (1.7%)
UNDISTURBED OPEN SPACE ON-SITE MITIGATION**	NOT REQUIRED	NOT REQUIRED	0.34 AC
UNDISTURBED OPEN SPACE OFF-SITE MITIGATION**	NOT REQUIRED	NOT REQUIRED	0.58 AC
BMP** WET POND	4,450 SF	14,140 SF	24,725 SF
BMP** UNDERGROUND DETENTION	570'-42" PIPE, 520'-60" PIPE	NOT REQUIRED	NOT REQUIRED
OFF-SITE IMPROVEMENTS	NOT REQUIRED	NOT REQUIRED	NOT REQUIRED

\* All site design elements are applied as required to meet conditions of draft ordinance/ordinances based on specific conditions of site and are subject to change with changing site conditions.

\*\* See Appendix for definitions.



**COST ESTIMATE SUMMARY**

ELEMENTS	EXISTING REGULATIONS	MINIMUM PERMIT REQUIREMENTS	PCCO-CENTRAL CATAWBA
ALLOWANCES	\$170,200	\$170,200	\$170,200
SITE GRADING	\$229,500	\$223,900	\$253,100
STORM DRAINAGE	\$877,200	\$443,400	\$486,100
WET POND RETAINING WALLS	-	\$381,600	\$529,900
EROSION CONTROL	\$65,300	\$65,300	\$65,300
ROOF DRAINS	\$89,300	\$89,300	\$89,300
WATER & SANITARY SEWER	\$579,000	\$579,000	\$579,000
STREETS	\$1,099,000	\$1,094,000	\$1,094,000
LITTORAL SHELF PLANTING	-	\$14,800	\$22,600
OPEN SPACE ON-SITE MITIGATION	N/R	N/R	\$6,400
OPEN SPACE OFF-SITE MITIGATION***	-	-	\$157,100
<b>TOTAL</b>	<b>\$3,109,600</b>	<b>\$3,061,600</b>	<b>\$3,453,000</b>

\* Peak flow and volume detention provided.

\*\* Water Quality (85% TSS), peak flow and volume detention provided.

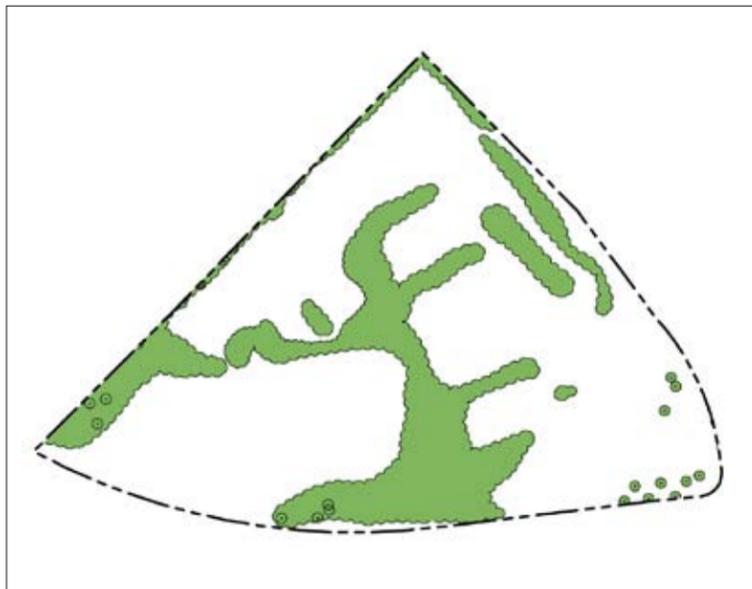
\*\*\* Since average land value in Charlotte is \$270,884, we assumed the developer would choose off-site mitigation versus the more costly payment in-lieu option (1.25 x per acre appraised land value).



# 1

## CONTEXT MAP

This site is located in a suburban area bounded by two boulevards. Rezoning as required to get commercial land use from the existing residential zoning.



# 2

## EXISTING TREE CANOPY

Around 20-25% of the site had existing tree canopy.



### DEVELOPMENT SUMMARY

- ZONING: N/A
- SITE ACREAGE (AC): 9.66
- BUILDING (SF): N/A
- PRIVATE ROADS (LF): N/A
- PERCENT IMPERVIOUS: 10-15%
- PARKING REQUIRED: N/R
- PARKING PROVIDED: N/R
- OPEN SPACE REQUIRED (AC): N/R
- OPEN SPACE PROVIDED (AC): N/R
- TREE SAVE REQUIRED (AC):N/R
- TREE SAVE PROVIDED (AC):N/R
- UNDISTURBED OPEN SPACE REQUIRED (AC): N/R
- UNDISTURBED OPEN SPACE PROVIDED (AC): N/R
- UNDISTURBED OPEN SPACE ON-SITE MITIGATION (AC): N/R
- UNDISTURBED OPEN SPACE OFF-SITE MITIGATION (AC): N/R
- BMP - WET POND: N/R
- BMP - UNDERGROUND DETENTION: N/R
- OFF-SITE IMPROVEMENTS: N/R

### COST ESTIMATE SUMMARY

- N/A

### NOTES

Existing conditions consists of a few residences on a large tract of property that has some tree canopy with open fields from potentially historic agricultural uses. Topography is relatively flat with the steepest grades near property boundary along the boulevards.



# 1

## UNDISTURBED OPEN SPACE

Undisturbed open space is not required under Existing Regulations. The Existing Regulations provided 0.16 AC of undisturbed open space.



# 2

## STORM WATER MANAGEMENT

Only storm water detention is required for the Existing Regulations. The plan treats the three drainage areas with a combination of underground detention and wet ponds.



### DEVELOPMENT SUMMARY

- ZONING: NS
- SITE ACREAGE (AC): 9.66
- BUILDING (SF): 99,829
- PRIVATE ROADS (LF): N/A
- PERCENT IMPERVIOUS: 83%
- PARKING REQUIRED: 167
- PARKING PROVIDED: 404
- OPEN SPACE REQUIRED (AC): N/R
- OPEN SPACE PROVIDED (AC): N/R
- TREE SAVE REQUIRED (AC):N/R
- TREE SAVE PROVIDED (AC):N/R
- UNDISTURBED OPEN SPACE REQUIRED (AC): N/R
- UNDISTURBED OPEN SPACE PROVIDED (AC): N/R
- UNDISTURBED OPEN SPACE ON-SITE MITIGATION (AC): N/R
- UNDISTURBED OPEN SPACE OFF-SITE MITIGATION (AC): N/R
- BMP - WET POND: 4,450 SF
- BMP - DRY DETENTION: 570' - 42" PIPE, 520' - 60" PIPE
- OFF-SITE IMPROVEMENTS: N/R

### COST ESTIMATE SUMMARY

- ALLOWANCES: \$170,200
- SITE GRADING: \$229,500
- STORM DRAINAGE: \$877,200
- WET POND RETAINING WALLS: N/R
- EROSION CONTROL: \$65,300
- ROOF DRAINS: \$89,300
- WATER & SANITARY SEWER: \$579,000
- STREETS: \$1,099,100
- LITTORAL SHELF PLANTING: N/R
- **TOTAL: \$3,109,600**

### NOTES

The Existing Regulations efficiently maximized its leasable square footage and parking. Driveway locations were basically predetermined by existing development. Underground detention and a typical wetpond with retaining wall meet detention requirements while keeping the parking ratio at around 4 parking spaces per 1000 SF of leasable space.



# 1

**UNDISTURBED OPEN SPACE**

Undisturbed open space is not required under the Minimum Permit Regulations. The Minimum Permit Requirements plan provided 0.16 AC of undisturbed open space.



# 2

**STORM WATER MANAGEMENT**

The Minimum Permit Requirements plan provided wet ponds to meet water quality and detention requirements. Retaining walls surround the wet ponds to maintain all Existing Regulations leasable square footage and minimize parking loss.

CASE STUDY #9  
MINIMUM PERMIT  
REQUIREMENTS**DEVELOPMENT SUMMARY**

- ZONING: NS
- SITE ACREAGE (AC): 9.66
- BUILDING (SF): 99,829
- PRIVATE ROADS (LF): N/A
- PERCENT IMPERVIOUS: 83%
- PARKING REQUIRED: 167
- PARKING PROVIDED: 362
- OPEN SPACE REQUIRED (AC): N/R
- OPEN SPACE PROVIDED (AC): N/R
- TREE SAVE REQUIRED (AC):N/R
- TREE SAVE PROVIDED (AC):N/R
- UNDISTURBED OPEN SPACE REQUIRED (AC): N/R
- UNDISTURBED OPEN SPACE PROVIDED (AC): N/R
- UNDISTURBED OPEN SPACE ON-SITE MITIGATION (AC): N/R
- UNDISTURBED OPEN SPACE OFF-SITE MITIGATION (AC): N/R
- BMP - WET POND: 14,140 SF
- BMP - UNDERGROUND DETENTION: N/R
- OFF-SITE IMPROVEMENTS: N/R

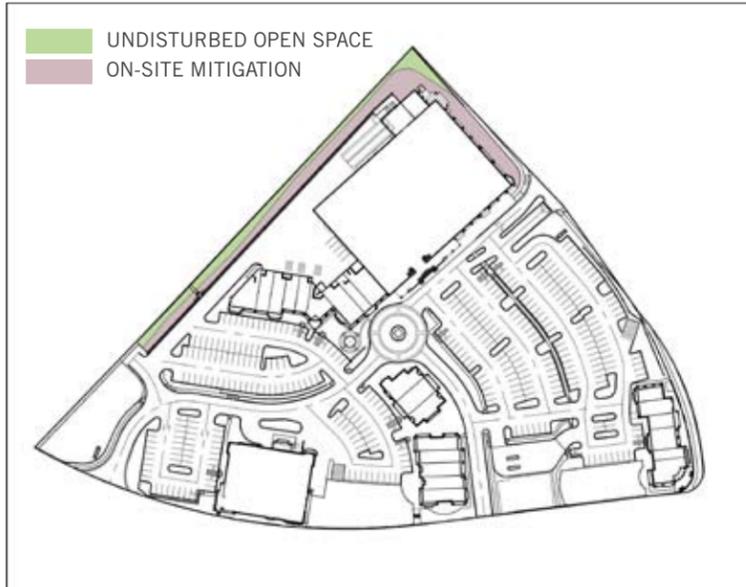
**COST ESTIMATE SUMMARY**

- ALLOWANCES: \$170,200
- SITE GRADING: \$223,900
- STORM DRAINAGE: \$443,400
- WET POND RETAINING WALLS: \$381,600
- EROSION CONTROL: \$65,300
- ROOF DRAINS: \$89,300
- WATER & SANITARY SEWER: \$579,000
- STREETS: \$1,094,000
- LITTORAL SHELF PLANTING: \$14,800
- **TOTAL: \$3,061,600**

**NOTES**

The use of wet ponds with retaining walls allows the Minimum Permit Requirements plan to keep all leasable square footage provided in the Existing Regulations. The wet ponds result in a parking loss that reduces the number of spaces per 1000 SF of leasable space from 4 spaces/1000 SF to 3.6 spaces/ 1000 SF.

CASE STUDY #10  
PCCO CENTRAL  
CATAWBA



# 1

**UNDISTURBED OPEN SPACE**

10% undisturbed open space is required under PCCO Central Catawba regulations. The PCCO Central Catawba plan provides 0.16 AC of undisturbed open space. 0.34 AC was mitigated on-site at a 150% mitigation rate. The remainder of undisturbed open space is satisfied with off-site mitigation.



# 2

**STORM WATER MANAGEMENT**

The PCCO Central Catawba plan provides wet ponds to meet water quality and detention requirements. Retaining walls surround the wet ponds to limit area needed for wet ponds.

CASE STUDY #10  
PCCO CENTRAL  
CATAWBA



### DEVELOPMENT SUMMARY

- ZONING: NS
- SITE ACREAGE (AC): 9.66
- BUILDING (SF): 99,829
- PRIVATE ROADS (LF): N/A
- PERCENT IMPERVIOUS: 83%
- PARKING REQUIRED: 167
- PARKING PROVIDED: 359
- OPEN SPACE REQUIRED (AC): N/R
- OPEN SPACE PROVIDED (AC): N/R
- TREE SAVE REQUIRED (AC): N/R
- TREE SAVE PROVIDED (AC): N/R
- UNDISTURBED OPEN SPACE REQUIRED (AC): 0.97 (10%)
- UNDISTURBED OPEN SPACE PROVIDED (AC): 0.16 (1.7%)
- UNDISTURBED OPEN SPACE ON-SITE MITIGATION (AC): 0.34
- UNDISTURBED OPEN SPACE OFF-SITE MITIGATION (AC): 0.58
- BMP - WET POND (SF): 24,725
- BMP - UNDERGROUND DETENTION: N/R
- OFF-SITE IMPROVEMENTS: N/R

### COST ESTIMATE SUMMARY

- ALLOWANCES: \$170,200
- SITE GRADING: \$253,100
- STORM DRAINAGE: \$486,100
- WET POND RETAINING WALLS: \$529,900
- EROSION CONTROL: \$65,300
- ROOF DRAINS: \$89,300
- WATER & SANITARY SEWER: \$579,000
- STREETS: \$1,094,000
- LITTORAL SHELF PLANTING: \$22,600
- OPEN SPACE ON-SITE MITIGATION: \$6,400
- OPEN SPACE OFF-SITE MITIGATION: \$157,100
- **TOTAL: \$3,453,000**

### NOTES

The PCCO Central Catawba plan retains all leasable square footage provided in Existing Regulations. The larger wet ponds reduce the parking ration to 3.6 spaces/1000 SF of leasable space. The wet ponds proximity to parking and retail provide opportunities for the wet ponds to become a feature.



# A

## APPENDIX

DEFINITIONS

DOWNSTREAM DETENTION ANALYSIS PROCEDURE

STAFF EVALUATION OF CASE STUDIES

PROJECT PROFORMA ANALYSIS - SINGLE FAMILY RESIDENTIAL

REFERENCES

PROJECT TEAM



**BEST MANAGEMENT PRACTICES (BMP)**

A structural management facility used singularly or in combination for storm water quality and quantity treatment to achieve water quality protection goals. (PCCO)

**BUILT UPON AREA (BUA)**

BUA is the portion of a project that is covered by impervious or partially impervious surface including, but not limited to buildings; pavement and gravel areas such as roads, parking lots and paths; and recreation facilities such as tennis courts. BUA does not include wooden slatted deck, the water area of a swimming pool, or pervious or partially pervious paving materials to the extent that the paving material absorbs water or allows water to infiltrate through a paving material.

**BUFFER**

A natural or vegetated area through which stormwater runoff flows in a diffuse manner so that the runoff does not become channelized and which provides for infiltration of the runoff and filtering of pollutants.

**DWELLING UNITS PER ACRE (DUA)**

The number of dwelling units per acre of land determined by dividing the number of dwelling units by the total number of acres in the parcel to be developed.

**DESIGN STORM FREQUENCY**

Frequency is the average time interval between equal magnitude floods. For example, a 25-year flood has the probability of occurrence of once every 25 years on the average, or a 4% chance of occurrence in any given year.

**GENERAL DEVELOPMENT POLICIES: PHASE II ENVIRONMENT (GDP-E)**

Draft guiding principles and policy statements for air, land and water, as revised at the 1-18-06 stakeholder meeting.

**IMPERVIOUS GROUND COVER**

Any structure or ground cover consisting of asphalt, concrete, stone, brick, terrazzo, roofing, ceramic tile or any other natural or man-made material that prevents the absorption of water into the soil.

**MINIMUM PERMIT REQUIREMENTS**

Minimum storm water standards required by Environment Protection Agency through National Pollution Discharge Elimination System (NPDES) permit.

**MITIGATION**

Actions taken either on-site or off-site as allowed by ordinance to offset the impacts of a certain action.

**UNDISTURBED OPEN SPACE AS PER PCCO**

Land that consists of natural areas containing trees and other natural shrubs consisting of either undisturbed areas or disturbed areas that have been replanted in accordance with the criteria established by ordinance.

**OPEN SPACE AS PER CHARLOTTE ZONING ORDINANCE**

An area of land or water, which is open and unobstructed including areas maintained in a natural or undisturbed character or areas improved for active or passive recreation. "Open space" shall not include water below the mean high water line located adjacent to the Catawba River and its impoundments, or areas covered with buildings, structures, streets or off-street parking areas, but shall include landscaping associated with such parking areas.

**POST CONSTRUCTION CONTROLS ORDINANCE (PCCO)**

Final stakeholders consensus document, dated October 4, 2005, of the Post-Construction Storm Water Ordinance.

**RE-DEVELOPMENT**

Rebuilding activities on land containing built upon area.

**SURFACE WATER IMPROVEMENT AND MANAGEMENT (S.W.I.M.) BUFFERS**

Chapter 12, Part 8 of the Code of City of Charlotte as amended by petition No. 99-119

**TOTAL PHOSPHORUS (TP)**

A nutrient that is essential to the growth of organisms but when it occurs in high enough concentrations it can negatively impact water quality conditions. Total phosphorus includes both dissolved and suspended forms of reactive phosphorus, acid hydrolysable phosphorus and organic phosphorus as measured by Standard Method 4500-P.

**TOTAL SUSPENDED SOLIDS (TSS)**

Total suspended matter in water which includes particles collected on a filter with pore size of 2 microns as measured by Standard Method 2540-D, which is commonly expressed as a concentration in terms of milligrams per liter (mg/L) or parts per million (PPM).

**TRANSIT STATION AREA AND DISTRESSED BUSINESS DISTRICT**

Areas designated by the planning director based on corridor record of decisions or designated by the economic development director as distressed.

DOWNSTREAM  
DETENTION ANALYSIS  
PROCEDURE

6/9/2005

**Overview of Downstream Analysis Procedure**

If a site designer chooses not to provide 25-yr 6-hr peak control, a downstream analysis must be done to look at features downstream from the site and assess potential flooding or erosion impacts due to development. Staff recommends that the downstream limit of the analysis is where the contributing watershed area from the development is 10% of the entire drainage area to that point. Said a different way, the analysis will go downstream to a point where the watershed area is 10 times the site area.

Although the detention exemption along floodplains will no longer be in the ordinance, most developments along the FEMA regulated floodplain will pass the 10 times the site area test. For example, any development on the floodway less than 64 acres will be below the 10% point.

The storms that will need to be analyzed will be based on what features are located within the limits of this study area. Design storms for various features are listed in the table below:

Design feature	Design storm for analysis (all 6-hr)
Closed pipe/Channel systems/Driveway culverts	10-year
Local street crossing	25-year
Thoroughfare street crossing	50-year
Building footprints	100-year

The design storms to be analyzed will depend upon what is downstream from the project site. For example, if there is only a local street crossing within the study area, only the 25-yr 6-hr storm would need to be modeled. The other storms would have to be analyzed as needed.

To establish impacts of development, two hydrologic models will need to be prepared:

- 1) Existing Conditions Analysis
- 2) Full Build-out of Watershed at current Zoning

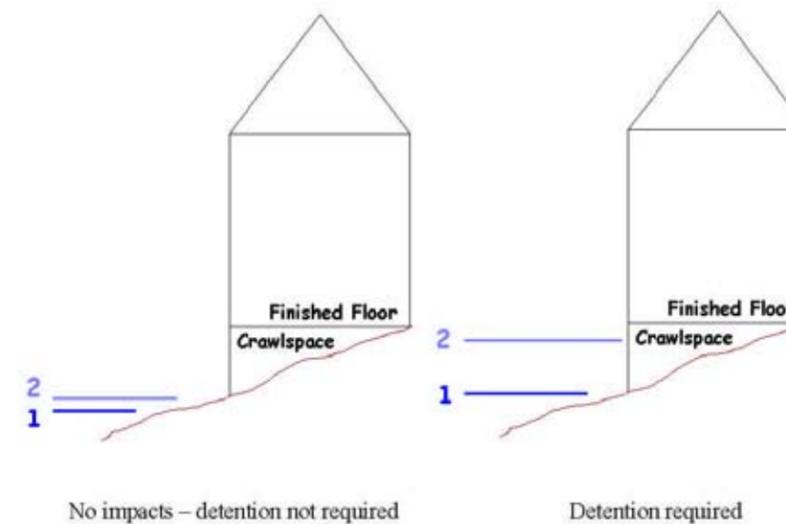
SWS would like to have an existing conditions model prepared to assess the current conditions of the storm drainage system. To consider options such as fee-in-lieu or upgrading downstream systems, this existing conditions analysis will be needed.

The full build-out model will assess the conditions after the watershed has completely developed. The full build-out assumption is consistent with current practices when developing models for 100+1 flood studies as required by the Subdivision Ordinance. If all the features within the study limits meet their design criteria, than no detention for flood control purposes will be required. *If detention for the 10-year event is not provided as a minimum ordinance requirement, then it is possible that detention to protect*

6/9/2005

*channels from downstream erosion may be required if an analysis indicates that damages will occur.*

For both models, the base survey will need to identify all features that could be affected by flooding to adequately assess impacts.



No impacts – detention not required

Detention required

	ENVIRONMENTALLY SENSITIVE AREAS PROTECTED OR MITIGATED <sup>1</sup>	FACILITATES ALTERNATIVE MODES OF TRANSPORTATION & REDUCED GROUND LEVEL TEMPERATURES	MINIMIZES IMPACT TO NATURAL FEATURES	REDUCES AMOUNT & IMPROVES QUALITY OF STORM WATER RUN-OFF	PROMOTES EFFICIENT WATER USE <sup>5</sup>
<b>SINGLE-FAMILY</b>					
CASE STUDY #1: USDG	YES	YES <sup>2,3</sup>	YES <sup>4</sup>	NO	N/A
CASE STUDY #2: MIN PERMIT REQ.	YES	YES	YES	YES	N/A
CASE STUDY #3: PCCO –CENTRAL	YES	YES	YES	YES	N/A
CASE STUDY #4: PCCO - WESTERN	YES	YES	YES	YES	N/A
CASE STUDY #5: PCCO-YADKIN	YES	YES	YES	YES	N/A
<b>URBAN INFILL</b>					
CASE STUDY #6: PCCO –TRANSIT	N/A <sup>6</sup>	YES	N/A <sup>6</sup>	YES	N/A
CASE STUDY #7: PCCO-CENTRAL	N/A <sup>6</sup>	YES	N/A <sup>6</sup>	YES	N/A
<b>MULTI-FAMILY</b>					
CASE STUDY #8: PCCO-CENTRAL	YES	N/A <sup>8</sup>	YES	YES	N/A
<b>COMMERCIAL</b>					
CASE STUDY #9: MIN PERMIT REQ.	N/A <sup>7</sup>	YES	N/A	YES	N/A
CASE STUDY #10: PCCO-CENTRAL	N/A <sup>7</sup>	YES	N/A	YES	N/A

## Notes:

1. Because the GDP-E has not yet been adopted the GIS layers have not been developed that could be used as a tool to help assess whether the site plan has met the intent of this policy. In the absence of such a formalized tool, staff used information available from the consultant's knowledge of existing conditions and recent aerials to evaluate the example sites.
2. Required street tree shade asphalt.
3. USDG provide connectivity which encourages walking and biking.
4. Preserves wetlands and respects floodplain.
5. Not applicable. Staff did not think the efficient use of water was applicable to any of the case studies reviewed.
6. Site was already developed and there were no environmentally sensitive areas or natural features remaining.
7. Little information was available on this site regarding existing conditions since it had been developed for several years. Therefore, due to the previous agricultural use of the site, it was assumed that there were no environmentally sensitive areas or natural features remaining to be protected.
8. Site is disconnected from surrounding area and thus does not facilitate walking or bicycling. But because the surrounding area has already been developed without connections, there is no opportunity for this site to connect.

PROFORMA ANALYSIS

**Analysis #1 - Absorb Cost in Sale Price of Home**

Site Acreage:	51.9 acres
Raw Land Cost:	\$2,600,000
Typical Single Family Home to House Ratio:	20%
Investment Return Requirement:	20%
Soft Cost Estimate:	\$1,000,000

Plan	Lot Yield	Density	Land Cost	Soft Cost	Development Cost	Dev. Cost Delta	Gross Sales	Profit	\$/Lot	Lot Cost Delta	House Price	House Price Delta	% Increase
Addendum 1 - Standard Regulations	186	3.6 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,464,140.00	\$ -	\$ 12,580,175.00	20%	\$ 67,635.35	\$ -	\$ 338,176.75	\$ -	0%
Existing Regulations	171	3.3 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,439,100.00	\$ (25,040.00)	\$ 12,548,875.00	20%	\$ 73,385.23	\$ 5,749.88	\$ 366,926.17	\$ 28,749.42	9%
Case Study #1-USDG	168	3.2 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,748,450.00	\$ 284,310.00	\$ 12,935,562.50	20%	\$ 76,997.40	\$ 9,362.05	\$ 384,986.98	\$ 46,810.23	14%
Case Study #2-Min. Permit Regulations	168	3.2 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,748,450.00	\$ 284,310.00	\$ 12,935,562.50	20%	\$ 76,997.40	\$ 9,362.05	\$ 384,986.98	\$ 46,810.23	14%
Case Study #3-PCCO Central	162	3.1 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,708,050.00	\$ 243,910.00	\$ 12,885,062.50	20%	\$ 79,537.42	\$ 11,902.07	\$ 397,687.11	\$ 59,510.37	18%
Case Study #4-PCCO Western	162	3.1 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,708,050.00	\$ 243,910.00	\$ 12,885,062.50	20%	\$ 79,537.42	\$ 11,902.07	\$ 397,687.11	\$ 59,510.37	18%
Case Study #5-PCCO Yadkin	156	2.9 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,608,150.00	\$ 144,010.00	\$ 12,760,187.50	20%	\$ 81,796.07	\$ 14,160.72	\$ 408,980.37	\$ 70,803.62	21%

- Notes:
1. Development Cost per City Analysis cost estimate.
  2. Gross Sales = (Land Cost+Soft Cost+Development Cost)/0.8
  3. Lot Cost = Gross Sales/Lot Yield
  4. House Price = 5xLot Cost (Assumes product change with increased lot cost).
  5. Land Cost and Soft Costs are assumed values.

**Analysis #2 - Absorb Cost in Sale Price of Land**

Site Acreage:	51.9 acres
Raw Land Cost:	TBD
Typical Single Family Home to House Ratio:	20%
Profit Return Requirement:	20%
Soft Cost Estimate:	\$1,000,000

Plan	Lot Yield	Density	Land Cost	Soft Cost	Development Cost	Dev. Cost Delta	\$/Lot	Gross Sales	House Price	Profit	Land Cost	Land Cost Delta	% Decrease
Addendum 1 - Standard Regulations	186	3.6 DUA	TBD	\$ 1,000,000.00	\$ 6,464,140.00	\$ -	\$ 67,635.35	\$ 12,580,175.00	\$ 338,176.75	20%	\$ 2,600,000.00	\$ -	0%
Existing Regulations	171	3.3 DUA	TBD	\$ 1,000,000.00	\$ 6,439,100.00	\$ (25,040.00)	\$ 67,635.35	\$ 11,565,644.76	\$ 338,176.75	20%	\$ 1,813,415.81	\$ (786,584.19)	-30%
Case Study #1-USDG	168	3.2 DUA	TBD	\$ 1,000,000.00	\$ 6,748,450.00	\$ 284,310.00	\$ 67,635.35	\$ 11,362,738.71	\$ 338,176.75	20%	\$ 1,341,740.97	\$ (1,258,259.03)	-48%
Case Study #2-Min. Permit Regulations	168	3.2 DUA	TBD	\$ 1,000,000.00	\$ 6,748,450.00	\$ 284,310.00	\$ 67,635.35	\$ 11,362,738.71	\$ 338,176.75	20%	\$ 1,341,740.97	\$ (1,258,259.03)	-48%
Case Study #3-PCCO Central	162	3.1 DUA	TBD	\$ 1,000,000.00	\$ 6,708,050.00	\$ 243,910.00	\$ 67,635.35	\$ 10,956,926.61	\$ 338,176.75	20%	\$ 1,057,491.29	\$ (1,542,508.71)	-59%
Case Study #4-PCCO Western	162	3.1 DUA	TBD	\$ 1,000,000.00	\$ 6,708,050.00	\$ 243,910.00	\$ 67,635.35	\$ 10,956,926.61	\$ 338,176.75	20%	\$ 1,057,491.29	\$ (1,542,508.71)	-59%
Case Study #5-PCCO Yadkin	156	2.9 DUA	TBD	\$ 1,000,000.00	\$ 6,608,150.00	\$ 144,010.00	\$ 67,635.35	\$ 10,551,114.52	\$ 338,176.75	20%	\$ 832,741.61	\$ (1,767,258.39)	-68%

- Notes:
1. Development Cost per City Analysis cost estimate.
  2. Gross Sales = Lot CostxLot Yield
  3. Lot Cost will be maintained per Existing Regulations estimate.
  4. House Price = 5xLot Cost
  5. Soft Costs are assumed values.
  6. Land Cost = (0.8xGross Sales)-Soft cost-Development Cost

**Analysis #3 - Absorb Cost in Sale Price of Home**

Site Acreage:	51.9 acres
Raw Land Cost:	\$2,600,000
Maintain constant materials and labor cost for home, maintain 20% profit margin	
Profit Return Requirement:	20%
Soft Cost Estimate:	\$1,000,000

Plan	Lot Yield	Density	Land Cost	Soft Cost	Development Cost	Dev. Cost Delta	Gross Sales	Profit	\$/Lot	Lot Cost Delta	House Price	House Price Delta	% Increase
Addendum 1 - Standard Regulations	186	3.6 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,464,140.00	\$ -	\$ 12,580,175.00	20%	\$ 67,635.35	\$ -	\$ 338,176.75	\$ -	0%
Existing Regulations	171	3.3 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,439,100.00	\$ (25,040.00)	\$ 12,548,875.00	20%	\$ 73,385.23	\$ 5,749.88	\$ 345,364.10	\$ 7,187.36	2%
Case Study #1-USDG	168	3.2 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,748,450.00	\$ 284,310.00	\$ 12,935,562.50	20%	\$ 76,997.40	\$ 9,362.05	\$ 349,879.31	\$ 11,702.56	3%
Case Study #2-Min. Permit Regulations	168	3.2 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,748,450.00	\$ 284,310.00	\$ 12,935,562.50	20%	\$ 76,997.40	\$ 9,362.05	\$ 349,879.31	\$ 11,702.56	3%
Case Study #3-PCCO Central	162	3.1 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,708,050.00	\$ 243,910.00	\$ 12,885,062.50	20%	\$ 79,537.42	\$ 11,902.07	\$ 353,054.34	\$ 14,877.59	4%
Case Study #4-PCCO Western	162	3.1 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,708,050.00	\$ 243,910.00	\$ 12,885,062.50	20%	\$ 79,537.42	\$ 11,902.07	\$ 353,054.34	\$ 14,877.59	4%
Case Study #5-PCCO Yadkin	156	2.9 DUA	\$ 2,600,000.00	\$ 1,000,000.00	\$ 6,608,150.00	\$ 144,010.00	\$ 12,760,187.50	20%	\$ 81,796.07	\$ 14,160.72	\$ 355,877.65	\$ 17,700.91	5%

## Notes:

1. Development Cost per City Analysis cost estimate.
2. Gross Sales = (Land Cost+Soft Cost+Development Cost)/0.8
3. Lot Cost = Gross Sales/Lot Yield
4. House Cost = Lot Cost+Labor/Materials/Soft Costs+Profit
5. Profit is maintained at 20% of House Cost
6. Labor/Materials/Soft Costs are kept constant with each estimate to maintain constant product.
7. Labor/Materials/Soft Costs = (0.8xHouse Cost)-Lot Cost
8. Land Cost and Soft Costs are assumed values.

REFERENCES LIST

1. Final Stakeholders' Consensus Document  
Charlotte Mecklenburg Post-Construction Storm Water Ordinance,  
Developed by the Post Construction Ordinance Stakeholders Group,  
April 2004 Through September 2005.
2. General Development Guidelines, Attachment #2, General Development  
Policies: Phase II, Draft Guiding Principles and Policy Statements for  
Air, Land, and Water.
3. Urban Street Design Guidelines, Draft for Public Review, Spring 2005.

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