Davidson Homes, LLC
Lot 49 Wellers Knoll Subdivision

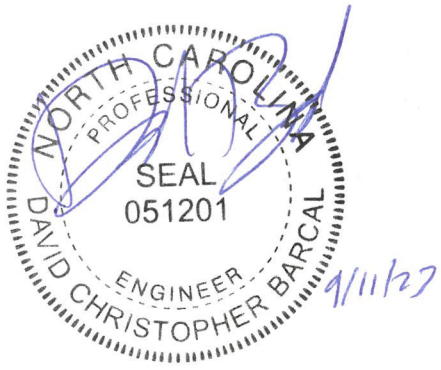
Flow Reduction Request

Harnett County, North Carolina

Project Number: A79723.00

Date of Preparation: September 11, 2023

PROJECT MANAGEMENT



Supporting Information &
Technical Specifications Prepared By:
MacConnell & Associates, P.C.
Full-Service Consulting Engineers

501 Cascade Pointe Lane, Ste 103
Cary, North Carolina 27513

Post Office Box 129
Morrisville, North Carolina 27560

Telephone: (919) 467-1239 Fax: (919) 319-6510

MacCONNELL & ASSOCIATES, P.C.

P.O. Box 129
Morrisville, NC 27560

(919) 467-1239

MacCONNELL & Associates, P.C.
"Engineering Today For Tomorrow's Future"

501 Cascade Pointe Lane
Suite 103
Cary, NC 27513

www.macconnellandassoc.com

Technical Memorandum

To: Harnett County Health Department
Client: Davidson Homes, LLC
Subject: Wellers Knoll Subdivision Lot 49

Date: September 11, 2023
From: David Barcal, P.E.
Project No.: A79723.00

This technical memorandum is a request for a design daily flow exemption to a residential dwelling using low flow fixtures as provided for in Session Law 2013-413 (House Bill 74) and Session Law 2014-120 Section 53 which relates to Rule 15A NCAC 18A .1949. Neither the State nor local health department shall be liable for any damages caused by an engineered system approved or permitted pursuant to Session Law 2014-120 Section 53.

Davidson Homes, LLC is developing the property located at Lot 49 of the Wellers Knoll Subdivision in Harnett County, NC. A copy of the soils report can be found in the Existing Information section of this application package. MacConnell & Associates, P.C. (M&A) is requesting a 25 percent flow reduction, using low-flow fixtures, to be incorporated into the design so that the home may be permitted as a 4-bedroom without needing to increase the size of the drainfield. The proposed treatment system is sized for the unadjusted flow of 480-GPD. The proposed initial and repair drainfields are sized for the reduced design flow of 360-GPD.

This request is for a flow reduction per provisions provided in Session Law 2013-413 and Session Law 2014-120. Typically, the basis for the design flow is provided in 15A NCAC 18A and prior regulations. The applicable regulations which preceded the 15A NCAC 18A rules and which served as the basis in determining flow in the 15A NCAC 18A rules: dates well before The Energy Policy Act of 1992 which established maximum flow rates for various fixtures in a nationwide effort to reduce both energy and water use. The flows which were established in the Act have recently been further reduced through the WaterSense program, which allows for labeling of fixtures which meet minimum criteria and conserve water.

Specifications for each fixture model can be found in the Proposed Fixtures section of this application package. A summary of the fixtures and flow rates can be found below in Table 1. A washing machine will be installed by the Owner in the future, so to calculate flow rates, M&A has elected to go with the base-rule flow to provide a conservative estimate

Table 1. Flow rates of proposed fixtures installed by builder.

Fixture	Manufacturer	Flow Rate	Units
Kitchen Faucet	Moen/Integra 67315	1.5	GPM
Bathroom Faucet	Moen/Chateau L4625	1.5	GPM
Master Bathroom Faucet	Moen/Chateau L4625	1.5	GPM
Showerheads	Moen/Chateau TL182	2.5	GPM
Toilets	Gerber/Maxwell MX-28-990	1.6	GPF

Table 2 identifies the type of fixture, flows for fixtures based on the 15A NCAC 18A rules (Flow A), and flows for proposed fixtures (Flow B). The savings or water conservation from both the rule-based flows and proposed conditions are presented in both flow and percent below (Table 2).

Table 2. Savings of water from rule-based flows with the proposed fixtures.

Fixture

Fixture	Units	Base/Rule Flow A	Proposed Flow B	A to B Savings	A to B % Savings
Kitchen Faucet	GPM	3.0	1.5	1.5	50%
Bathroom Faucet	GPM	3.0	1.5	1.5	50%
Showerhead	GPM	5.5	2.5	3.0	55%
Toilet	GPF	3.5	1.6	1.9	54%
Clothes Washer	GPL	32.0	32.0	0.0	0%

Documentation for the above values is presented at the end of this discussion. The documentation includes:

1. Rule basis of flow and effective dates of rule.
2. Typical indoor water use.
3. Proposed fixtures.
4. Supporting documentation including historical flow rates for fixtures.
5. Technical Advisory Council Report for Wastewater Flows from Single Family Dwellings
6. Existing Information.

The projected flows using rule-based design flowrates would be:

Unadjusted Design Flow per Rule (15A NCAC 18A and prior regulations)

Description	No.	Flow/Unit	Total
Bedrooms	4	120 GPD	480 GPD
Total			480 GPD

Using the information presented above on flow A and B, the projected water use is presented in Table 3 below. The savings presented are from fixture rates when the rules were made effective in comparison to the flow rates with the proposed fixtures.

Fixture	% Use	Base Flow GPD	% Savings	Savings GPD	Adjusted GPD	
Kitchen Faucet	6%	29	50%	14	14	
Bathroom Faucet	10%	48	50%	24	24	
Showerhead*	19%	91	55%	50	41	
Toilet	28%	134	54%	73	61	
Clothes Washer	22%	106	0%	0	106	
Leaks & Other	15%	72	0%	0	72	
Total	100%	480	34%	161	319	66%

Notes:

*Highest water use shower head used in analysis.

The projected flow of 319 GPD is approximately sixty-six percent of the design flow which we have found to be typical of homes with water conscious fixtures. We are requesting a 25 percent reduction or a design flow for subsurface disposal of 360 GPD.

Analysis of wastewater shows that with the flow reduction, the waste is not considered high strength at presented below:

	Base Flow Concentration	Reduced Flow Concentration (220/1-.25)	High Strength
BOD_5	220 mg/l	293 mg/l	350 mg/l
TSS	220 mg/l	293 mg/l	350 mg/l

Thus, the effluent from the septic tank is expected to be similar to a non-reduced flow effluent. Based on this analysis, the use of low-flow fixtures provides sufficient remaining capacity. We respectfully ask for acceptance of this proposal.

Table of Contents

1. Rule basis of flow and effective dates of rule.

15A NCAC 18A .1949 SEWAGE FLOW RATES FOR DESIGN UNITS

(a) In determining the volume of sewage from dwelling units, the flow rate shall be 120 gallons per day per bedroom. The minimum volume of sewage from each dwelling unit shall be 240 gallons per day and each additional bedroom above two bedrooms shall increase the volume of sewage by 120 gallons per day. In determining the number of bedrooms in a dwelling unit, each bedroom and any other room or addition that can reasonably be expected to function as a bedroom shall be considered a bedroom for design purposes. When the occupancy of a dwelling unit exceeds two persons per bedroom, the volume of sewage shall be determined by the maximum occupancy at a rate of 60 gallons per person per day.

(b) Table No. I shall be used to determine the minimum design daily flow of sewage required in calculating the design volume of sanitary sewage systems to serve selected types of establishments. The minimum design volume of sewage from any establishment shall be 100 gallons per day. Design of sewage treatment and disposal systems for establishments not identified in this Rule shall be determined using available flow data, water-using fixtures, occupancy or operation patterns, and other measured data.

TABLE NO. I

TYPE OF ESTABLISHMENT	DAILY FLOW FOR DESIGN
Airports (Also R.R. stations, bus terminals --not including food service facilities)	5 gal/passenger
Barber Shops	50 gal/chair
Bars, Cocktail Lounges (Not including food service)	20 gal/seat
Beauty Shops (Style Shops)	125 gal/chair
Bowling Lanes	50 gal/lane
Businesses (other than those listed elsewhere in this table)	25 gal/employee
Camps	
Construction or Work Camps	60 gal/person 40 gal/person (with chemical toilets)
Summer Camps	60 gal/person
Campgrounds -- With Comfort Station (Without water and sewer hookups)	100 gal/campsite
Travel Trailer/Recreational Vehicle Park (With water and sewer hookups)	120 gal/space
Churches (Not including a Kitchen, Food Service Facility, Day Care or Camp)	3 gal/seat
Churches (With a Kitchen but, not including a Food Service Facility, Day Care, or Camp)	5 gal/seat
Country Clubs	20 gal/member
Day Care Facilities	15 gal/person
Factories (Exclusive of industrial waste)	25 gal/person/shift
Add for showers	10 gal/person/shift
Food Service Facilities	
Restaurants	40 gal/seat or 40 gal/15 ft2 of dining area, whichever is greater
24-hour Restaurant	75 gal/seat
Food Stands	
(1) Per 100 square feet of food stand floor space	50 gal
(2) Add per food employee	25 gal
Other Food Service Facilities	5 gal/meal
Hospitals	300 gal/bed
Marinas	10 gal/boat slip
With bathhouse	30 gal/boat slip
Meat Markets	

(1) Per 100 square feet of market floor space	50 gal
(2) Add per market employee	25 gal
Motels/Hotels	120 gal/room
With cooking facilities	175 gal/room
Offices (per shift)	25 gal/person
Residential Care Facilities	60 gal/person
Rest Homes and Nursing Homes	
With laundry	120 gal/bed
Without laundry	60 gal/bed
Schools	
Day Schools	
With cafeteria, gym, and showers	15 gal/student
With cafeteria only	12 gal/student
With neither cafeteria nor showers	10 gal/student
Boarding Schools	60 gal/person
Service Stations	250 gal/water closet or urinal
24-hour Service Stations	325 gal/water closet
Stores, Shopping Centers, and Malls (Exclusive of food service and meat markets)	120 gal/1000 ft2 of retail sales area
Stadium, Auditorium, Theater, Drive-in	5 gal/seat or space
Swimming Pools, Spas, and Bathhouses	10 gal/person

(c) An adjusted design daily sewage flow may be granted by the local health department upon a showing as specified in Subparagraphs (c)(1) through (c)(2) that a sewage system is adequate to meet actual daily water consumption from a facility included in Paragraph (b) of this Rule.

(1) Documented data from that facility or a comparable facility justifying a flow rate reduction shall be submitted to the local health department and the State. The submitted data shall consist of at least 12 previous consecutive monthly total water consumption readings and at least 30 consecutive daily water consumption readings. The daily readings shall be taken during a projected normal or above normal sewage flow month. A peaking factor shall be derived by dividing the highest monthly flow as indicated from the 12 monthly readings by the sum of the 30 consecutive daily water consumption readings. The adjusted design daily sewage flow shall be determined by taking the numerical average of the greatest ten percent of the daily readings and multiplying by the peaking factor. Further adjustments shall be made in design sewage flow rate used for sizing nitrification fields and pretreatment systems when the sampled or projected wastewater characteristics exceed those of domestic sewage, such as wastewater from restaurants or meat markets.

(2) An adjusted daily sewage flow rate may be granted contingent upon use of extreme water-conserving fixtures, such as toilets which use 1.6 gallons per flush or less, spring-loaded faucets with flow rates of one gallon per minute or less, and showerheads with flow rates of two gallons per minute or less. The amount of sewage flow rate reduction shall be determined by the local health department and the State based upon the type of fixtures and documentation of the amount of flow reduction to be expected from the proposed facility. Adjusted daily flow rates based upon use of water-conserving fixtures shall apply only to design capacity requirements of dosing and distribution systems and nitrification fields. Minimum pretreatment capacities shall be determined by the design flow rate of Table I of this Rule.

History Note: *Authority G.S. 130A-335(e);*
Eff. July 1, 1982;
Amended Eff. January 1, 1990; January 1, 1984.

2. Typical indoor water use.

Indoor Water Use at Home

gracelinks.org/124/indoor-water-use-at-home

Shutterstock.com

Fortunately, when we want fresh, clean water, all most of us have to do is turn on a faucet. On average, our direct indoor water use (water you use from your tap, toilet, dishwasher, etc.) adds up to about 60 gallons of water a day per person.

Here's how indoor water use breaks down:

- Toilets (28 percent)
- Washing Machines (22 percent)
- Showers and Baths (19 percent)
- Sinks (16 percent)
- Household Leaks (14 percent)

That last number is surprising – it's almost 10 gallons of water per person per day lost to leaky toilets and faucets.

Conserving Water with Water-Efficient Toilets, Showerheads and More

Fortunately, saving water around the house is easier today than ever before. Newer (low-flow) toilets, showerheads and faucets are designed to be more efficient than older models and can save your household gallons every day. For example, older toilets use up to 7 gallons per flush, whereas low-flow toilets use 1.5 gallons or less.

Likewise, older showerheads flow over 4 gallons per minute, while low-flow models can flow as low as 1.5 gallons per minute. Be careful what showerhead you purchase, though, because some fixtures, especially those with multiple nozzles, exceed the federal limit of 2.5 gallons per minute. If you use one of those, consider cutting back your shower time.

Check out EPA's WaterSense website for water- and energy- saving products. In addition, you can find energy- and water-saving appliances like dishwashers and washing machines through DOE's ENERGY STAR label. By switching to water-saving fixtures and appliances you can reduce your indoor water use by a third on average.

Heating is a Water and Energy Hog!

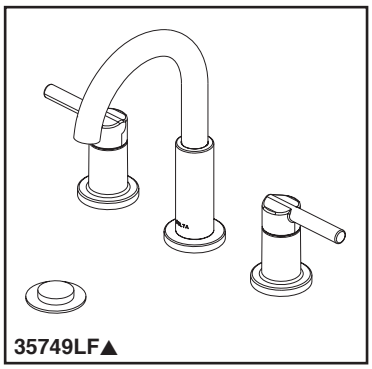
In most households water heating is a huge energy user, after indoor heating and cooling, appliances, electronics and lighting. So sadly, long hot showers waste both water and energy! Although modern fixtures and appliances are a great way to save gallons, it's still important to simply turn off the tap.

By taking simple steps to reduce your water use at home you can save gallons, energy and dollars every day! To find lots of ways to save water and energy visit the Water Saving Tips page.

***

Did You Know? Washing dishes by hand takes about 20 gallons per load but Energy Star dishwashers only use 4 to 6 gallons. Even standard machines use only 6 to 8 gallons. If you do wash dishes by hand, turn off the tap until you're ready to rinse.

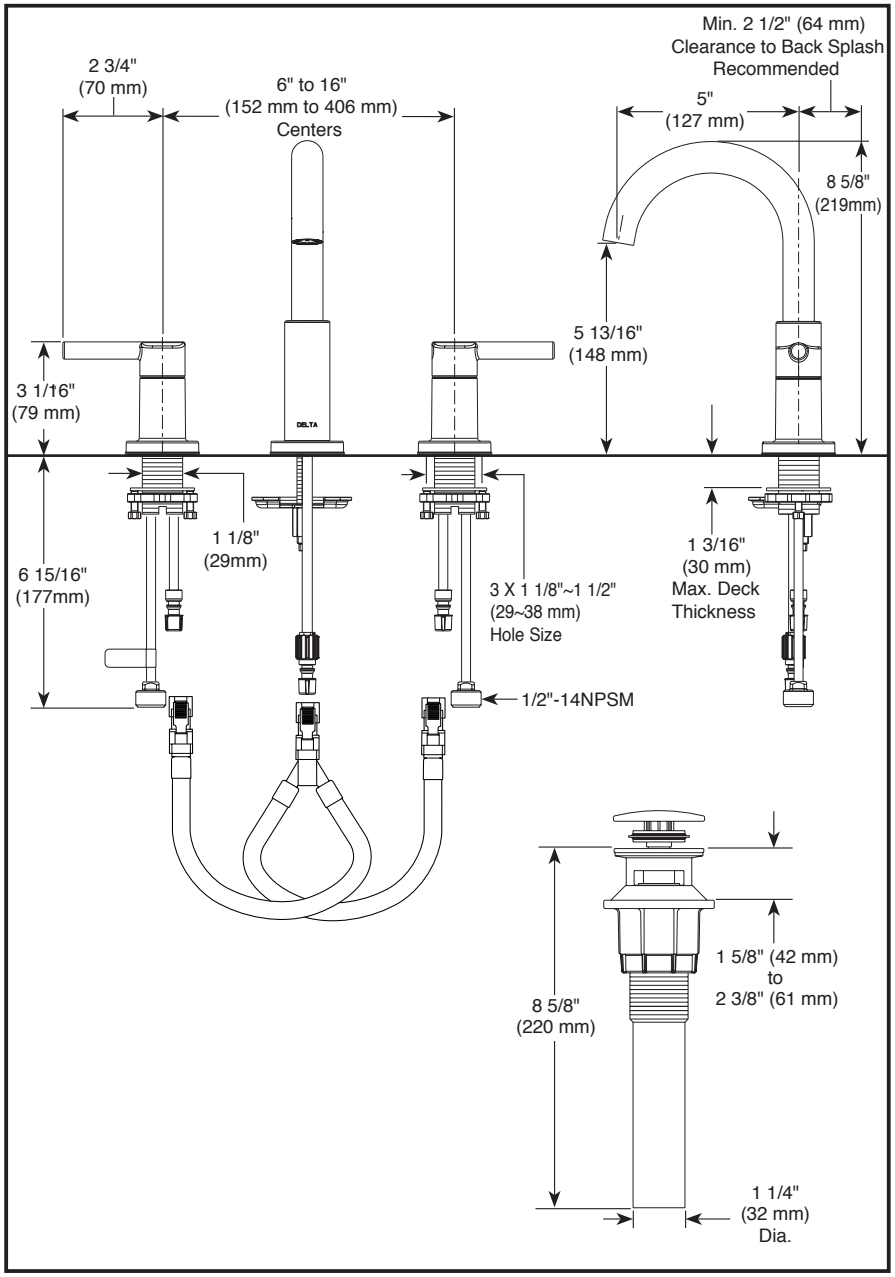
3. Proposed fixtures.



35749LF▲

Submitted Model No.: _____

Specific Features: _____



▲ Designate proper finish suffix

DELTA

see what Delta can do℠

BATHROOM FAUCET

■ Nicoli® Collection

■ Two Handle Widespread, Deck Mount

STANDARD SPECIFICATIONS:

- Max. flow rate 1.2 gpm @ 60 psi, 4.5 L/min @ 414 kPa
- Solid brass end valves and spout body
- Three hole mount
- Hot and cold stems are interchangeable
- 1/4 turn handle stops
- 1/4" O.D. coper supply lines
- Control mechanism is a rotating cylinder type with stainless steel plate and 90° rotation, with replaceable non-metallic seats
- Models have drain with pop-up type fitting with plated flange and stopper

WARRANTY

- Parts and Finish - Lifetime limited warranty; or for commercial purchasers, 10 years for multi-family residential (apartments and condominiums) and 5 years for all other commercial uses, in each case from the date of purchase.
- Electronic Parts and Batteries (if applicable) - 5 years from the date of purchase; or for commercial purchasers, 1 year from the date of purchase. No warranty is provided on batteries.

WaterSense Meets EPA Criteria
Certified by CSA Group

COMPLIES WITH:

- ASME A112.18.1 / CSA B125.1
- ASME A112.18.2 / CSA B125.2

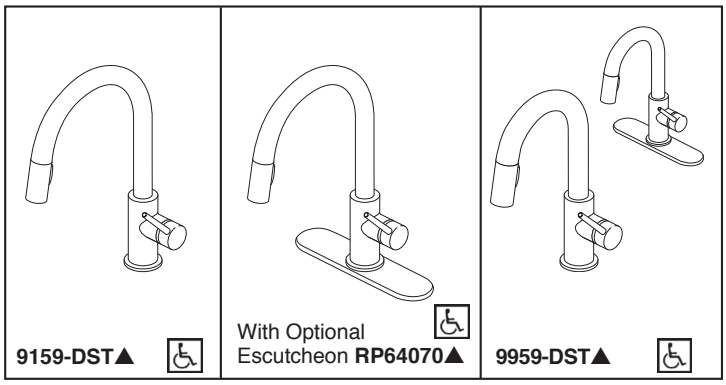
Indicates compliance to ICC / ANSI A117.1 - Valve control only

- EPA WaterSense®

Delta reserves the right (1) to make changes in specifications and materials, and (2) to change or discontinue models, both without notice or obligation. Dimensions are for reference only. See current full-line price book or www.deltafaucet.com for finish options and product availability.

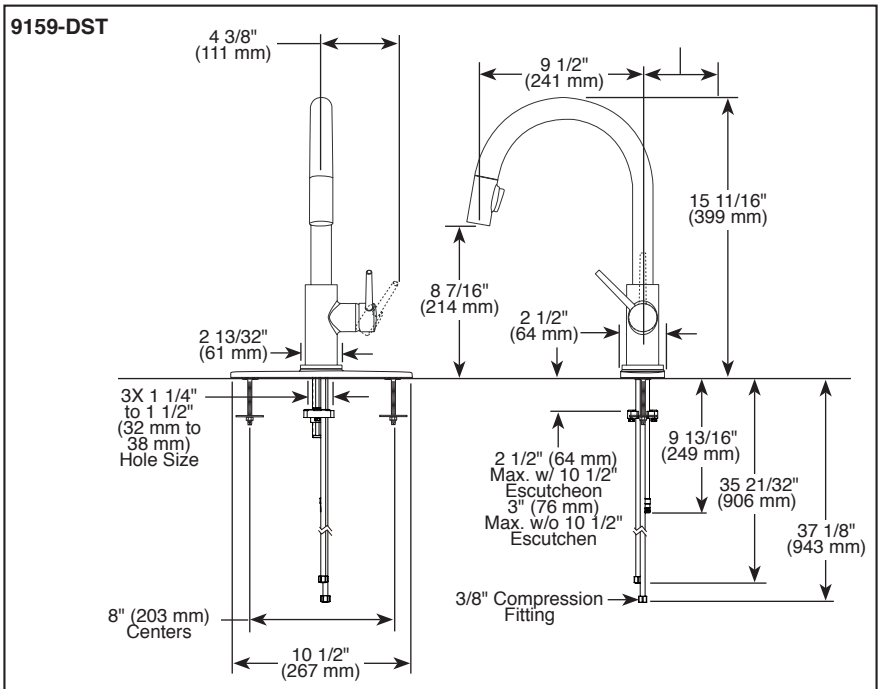
DSP-L-35749LF Rev. B

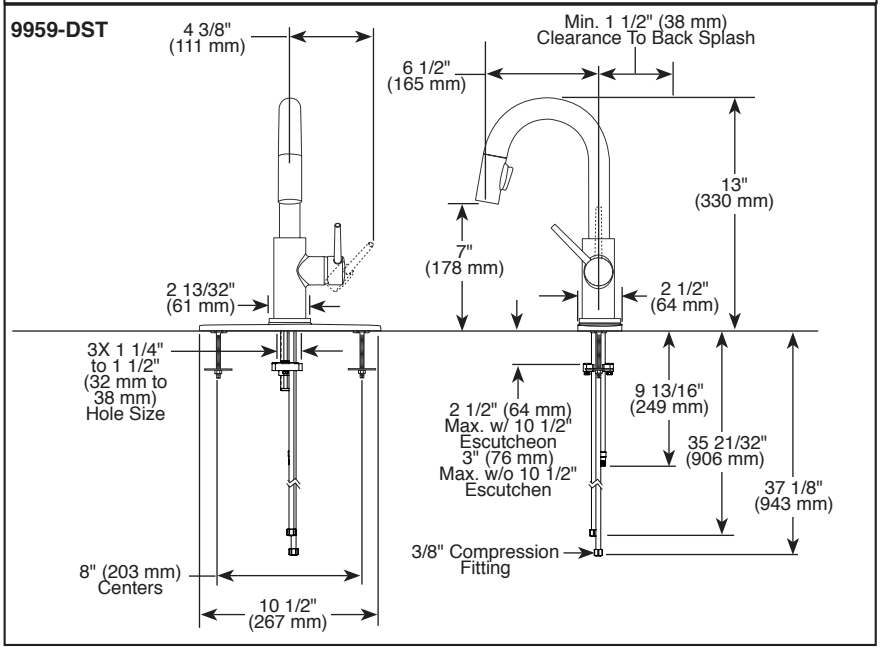
Delta Faucet Company
55 E. 111th Street, Indianapolis, IN 46280
350 South Edgeware Road, St. Thomas, ON N5P 4L1



Submitted Model No.:_____

Specific Features: _____





▲ Designate proper finish suffix

Delta reserves the right (1) to make changes in specifications and materials, and (2) to change or discontinue models, both without notice or obligation. Dimensions are for reference only. See current full-line price book or www.deltafaucet.com for finish options and product availability.

DSP-K-9159-DST Rev. F

see what Delta can do℠

KITCHEN FAUCETS

- Trinsic® Collection
- Single Handle Deck Mount
- 2-Function Pull-Down Sprayer

FEATURES:

- MagnaTite® Magnetic System
- DIAMOND Seal® Technology
- Touch-Clean® Sprayhead

STANDARD SPECIFICATIONS:

- Maximum 1.8 gpm @ 60 psi, 6.8 L/min @ 414 kPa
- One or three hole mount (escutcheon optional, not included)
- Spout rotates 360˚
- Control mechanism shall be full-motion valve cartridge
- Two-function wand; Aerated stream or spray
- Red/blue indicator markings
- Dual integral check valves in sprayer
- Quick connect hoses

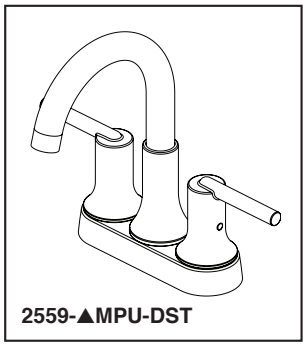
WARRANTY

- Parts and Finish - Lifetime limited warranty; or for commercial purchasers, 10 years for multi-family residential (apartments and condominiums) and 5 years for all other commercial uses, in each case from the date of purchase.
- Electronic Parts and Batteries (if applicable) - 5 years from the date of purchase; or for commercial purchasers, 1 year from the date of purchase. No warranty is provided on batteries.

COMPLIES WITH:

- ASME A112.18.1 / CSA B125.1
- ASME A112.18.6
- Indicates compliance to ICC/ANSI A117.1
- Verified compliant with .25% weighted average Pb content regulations.

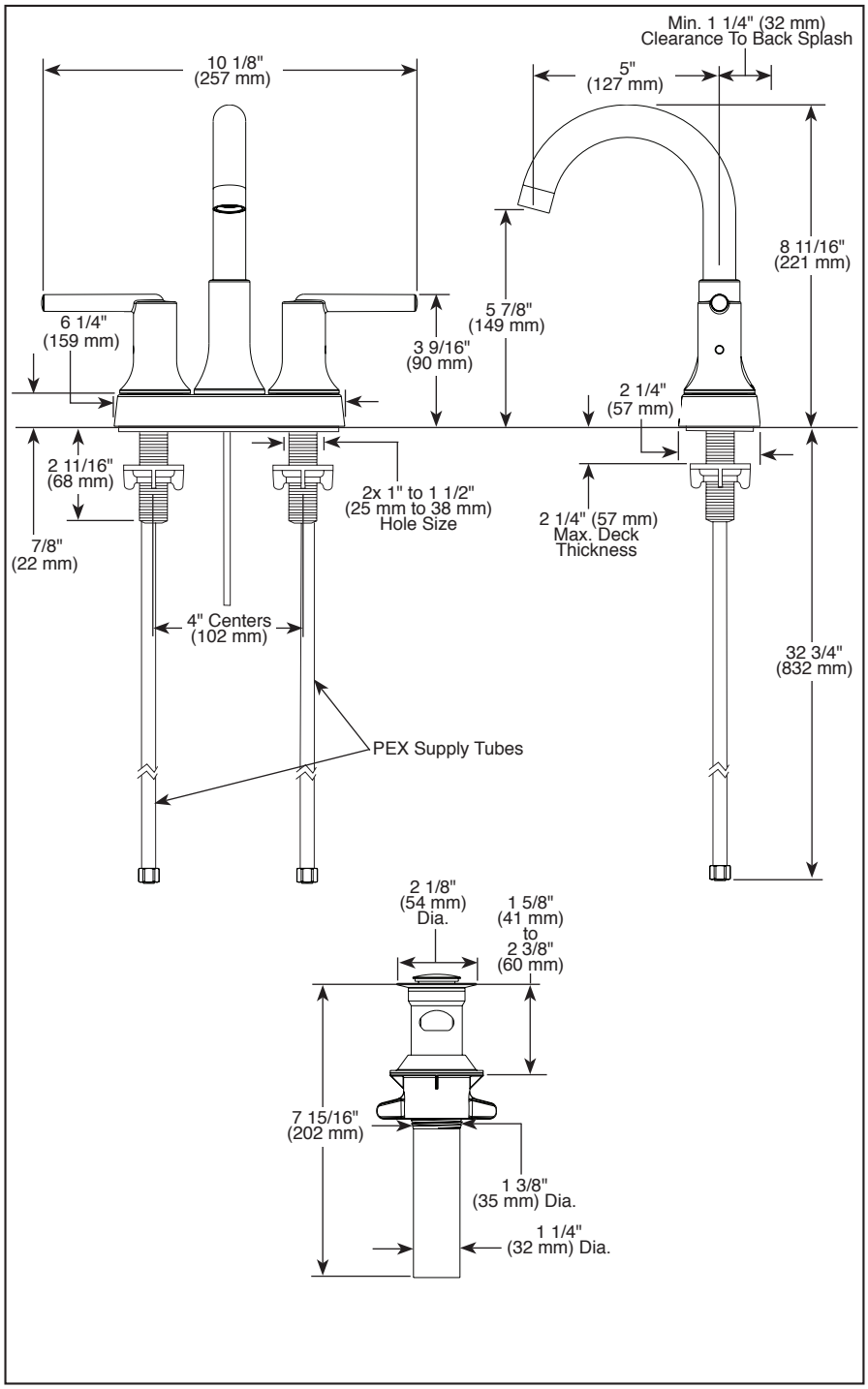
Delta Faucet Company
55 E. 111th Street, Indianapolis, IN 46280
350 South Edgeware Road, St. Thomas, ON N5P 4L1



2559-▲MPU-DST

Submitted Model No.:_____

Specific Features: _____



▲ Designate Proper Finish Suffix

Delta reserves the right (1) to make changes in specifications and materials, and (2) to change or discontinue models, both without notice or obligation. Dimensions are for reference only. See current full-line price book or www.deltafaucet.com for finish options and product availability.

DSP-L-2559-MPU-DST Rev. F

DELTA

see what Delta can do℠

BATHROOM FAUCET

- Trinsic™ Bath Collection
- Two Handle Deck Mount

FEATURES:

- DIAMOND Seal® Technology

STANDARD SPECIFICATIONS:

- Max flow rate 1.2 gpm @ 60 psi, 4.5 L/min @ 414 kPa
- Three hole mount
- 1/4 turn handle stops
- Diamond coated ceramic cartridge
- Hot and cold stems are interchangeable.
- 3/8" O.D. straight PEX supply tubes
- Models have metal drain with push-pop type fitting with plated flange and stopper

WARRANTY

- Parts and Finish - Lifetime limited warranty; or for commercial purchasers, 10 years for multi-family residential (apartments and condominiums) and 5 years for all other commercial uses, in each case from the date of purchase.
- Electronic Parts and Batteries (if applicable) - 5 years from the date of purchase; or for commercial purchasers, 1 year from the date of purchase. No warranty is provided on batteries.

WaterSense · Meets EPA Criteria · Certified by CSA Group

COMPLIES WITH:

- ASME A112.18.1 / CSA B125.1
- ASME A112.18.2 / CSA B125.2
  Indicates compliance to ICC/ANSI A117.1 - Valve control only
- EPA WaterSense®
- Verified compliant with 0.25% weighted average Pb content regulations.

Delta Faucet Company
55 E. 111th Street, Indianapolis, IN 46280
350 South Edgeware Road, St. Thomas, ON N5P 4L1

Submitted Model No.:_____

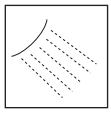
Specific Features: _____

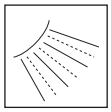
RAINCAN SHOWERHEAD

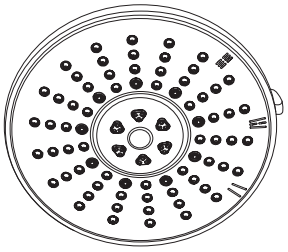
■ Raincan Showerhead

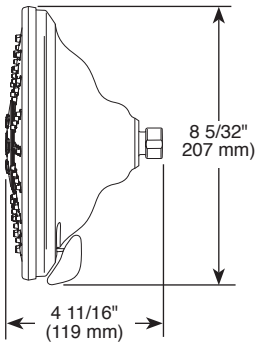
52680▲ Showerhead


Full Body Spray


Massaging Spray

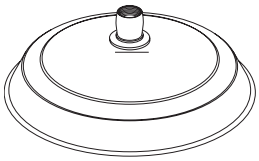

Full Spray w/Massage

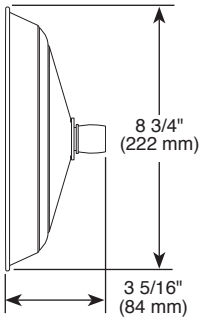




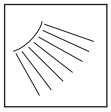
52682▲ Showerhead

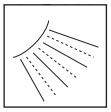

Soft Rain Spray

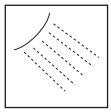




52683▲ Showerhead

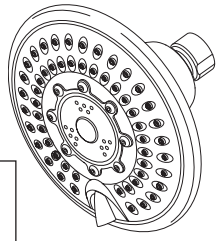

Full Body Spray

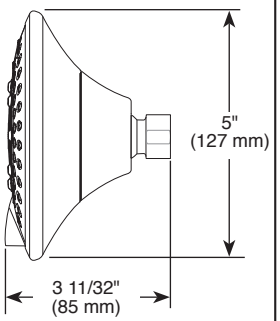

Full Spray w/Massage


Massaging Spray


Aerated Spray

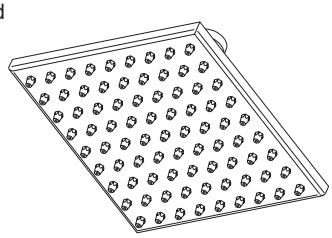

Pause

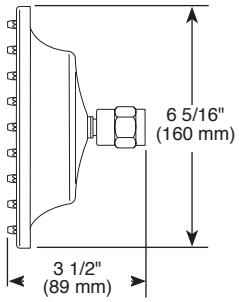




52689▲ Showerhead

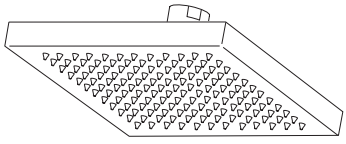

Soft Rain Spray

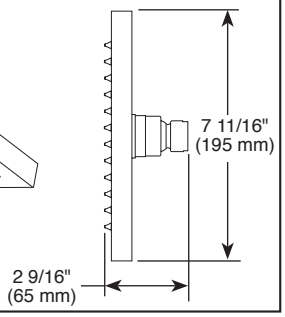




57740▲ Showerhead


Full Body Spray





▲ Designate proper finish suffix

Delta reserves the right (1) to make changes in specifications and materials, and (2) to change or discontinue models, both without notice or obligation. Dimensions are for reference only. See current full-line price book or www.deltafaucet.com for finish options and product availability.

DSP-B-52680 Rev. C

STANDARD SPECIFICATIONS

- Maximum 2.5 gpm at 80 psi (9.5L/Min @ 552 kPa)
- One to five spray showerhead
- 5"-8 1/2" spray face diameter
- Brass construction: 52682, 52689
- Touch-clean spray holes: 52680, 57740, 52683

WARRANTY

- Lifetime limited warranty on parts (other than electronic parts and batteries) and finishes: or, for commercial users, for 5 years from date of purchase.
- 5 year limited warranty on electronic parts (other than batteries); or, for commercial users, for 1 year from the date of purchase. No warranty is provided on batteries.

COMPLIES WITH:

- ASME A112.18.1 / CSA B125.1

DELTA FAUCET COMPANY

55 E. 111th Street, Indianapolis, Indiana 46280
350 South Edgeware Road, St. Thomas, ON N5P 4L1

C43913▲

see what Delta can do℠

Foundations® Toilet C43913▲

STANDARD SPECIFICATIONS:

- Vitreous China
- 29 9/32" (744 mm) in length, 17 1/2" (445 mm) in width, 30 13/16" (783 mm) in height.
- Elongated bowl with chair height design 16 1/2" (419 mm) to top of the bowl.
- 12" (305 mm) rough-in.
- High efficiency 1.28 gpf (4.8 lpf).
- 3" (76 mm) flush valve.
- 2" (51mm) fully glazed trapway.
- Includes polished chrome trip lever.

WARRANTY

- Chinaware – Lifetime limited warranty; or for commercial purchasers, 10 years for multi-family residential (apartments and condominiums) and 5 years for all other commercial uses, in each case from the date of purchase.
- Mechanical Parts – 1 year from the date of purchase.
- Electronic Parts and Batteries (if applicable) – 5 years from the date of purchase; or for commercial purchasers, 1 year from the date of purchase. No warranty is provided on batteries.
- Toilet Seats – 1 year from the date of purchase. For commercial purchasers no warranty is given.

COMPLIES WITH

- ADA / ANSI A117.1
- ASME A112.19.2 / CSA B45.1
- ASME A112.19.5
- EPA WaterSense® High Efficiency Toilet
- CalGreen

Technical Information	
Fixture configuration	Two-piece, elongated bowl
Water per flush	1.28 gpf (4.8 lpf)
Passageway	2" (51mm)
Water area	9 1/16" X 6 5/32" (230 mm x156 mm)
Seat post hole centers	5 1/2" (140 mm)
Included Components:	
Tank Assembly	RP81873▲
Tank Cover	RP82448▲
Flush Lever	RP82450▲
Mounting Hardware – Bowl to floor	RP100489
Mounting Hardware – Tank to bowl	RP82451
Seat Assembly	RP92086▲

▲ Designate proper finish suffix (-WH for white)

Installation Notes

- Install this product according to the installation guide.
- This model complies with the American Disabilities Act (ADA) when installed per the requirements of the Accessibility Guidelines, Section 604 Water Closets, of the Act, which includes the installation of an open front seat (not included).
- This model complies with CSA B651 when installed per Clause 4.3.6 of the standard.

Delta Faucet Company
55 E 111th Street, Indianapolis, Indiana 46280
350 South Edgeware Road, St. Thomas, ON N5P 4L1

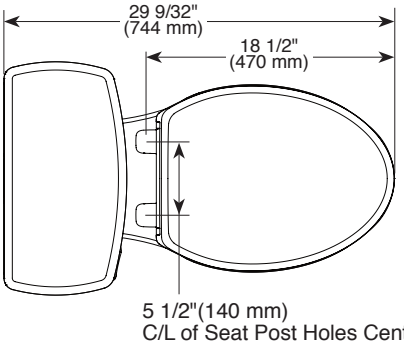
see what Delta can do™

Foundations® Toilet
C43913▲

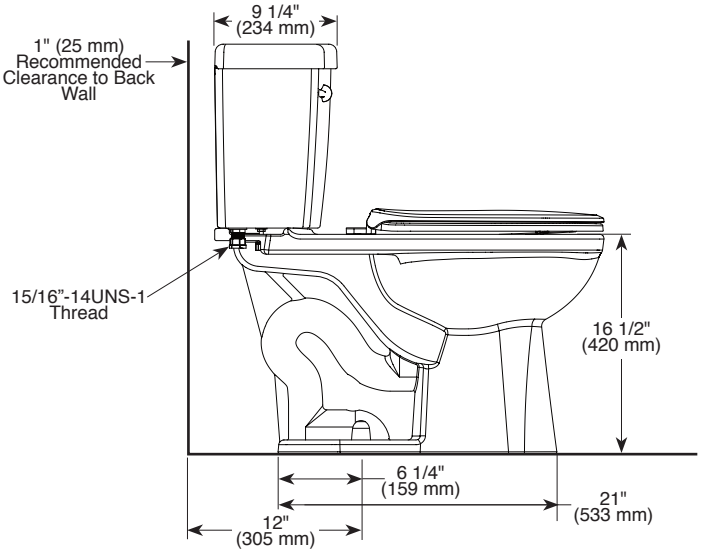
Submitted Model No.: _____

Specific Features: _____

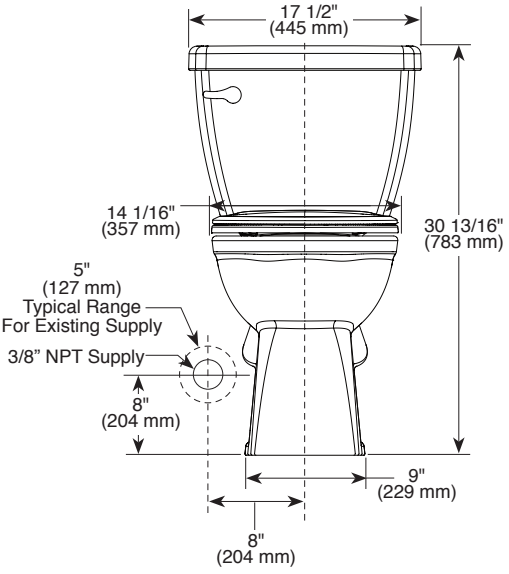
Top down view



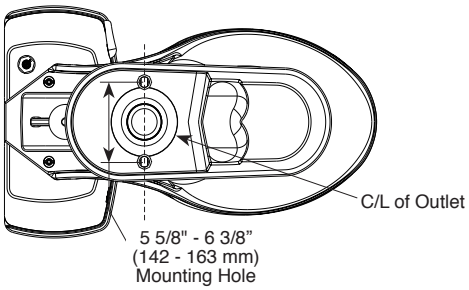
Left view



Front view



Foot Print



▲ Designate proper finish suffix (-WH for white)

Delta reserves the right (1) to make changes in specifications and materials, and (2) to change or discontinue models, both without notice or obligation. Dimensions are for reference only. See full-line pricebook or www.deltatoilet.com for finish options and product availability.

4. Supporting documentation including historical flow rates for fixtures and washer.

WaterSense® High-Efficiency Lavatory Faucet Specification

Supporting Statement

I. Introduction

The WaterSense program released its High-Efficiency Lavatory[1] Faucet Specification (specification) on October 1, 2007, to promote and enhance the market for water-efficient lavatory faucets. The goal of this specification is to allow consumers to identify and differentiate products in the marketplace that meet this specification's criteria for water efficiency and performance.

This specification addresses lavatory faucets and lavatory faucet accessories[2] in private use, such as those found in residences, and private restrooms in hotels and hospitals. Since these types of faucets are used primarily for hand washing and other sanitary activities, such as face washing and razor rinsing, WaterSense believes that maximum flow rates can be reduced enough to impact national water consumption while at the same time not negatively impacting user satisfaction. This specification is not intended to address kitchen faucets, which have a very different set of uses and performance criteria, or public restroom faucets (e.g., airports, theaters, arenas, stadiums, offices, and restaurants), which already have national performance standards and criteria to which they should conform.

II. Current Status of Faucets

WaterSense estimates that currently there are 222 million residential lavatory faucets in the United States. This estimate is based on an assumed one-to-one ratio of lavatory faucets to residential bathrooms.[3] In addition to the existing stock, approximately 25 million new faucets are sold each year for installation in new homes or replacement of aging fixtures in existing homes.[4] Of these 25 million faucets, roughly two-thirds of those are lavatory faucets (approximately 17 million units). Residential lavatory and kitchen faucets account for

[1] Lavatory is the terminology used in the Energy Policy Act of 1992 and ASME A112.18.1 to describe the types of faucets to which the standards apply. In this specification, lavatory means any bathroom sink faucets intended for private use.

[2] Accessory, as defined in ASME 112.18.1, means a component that can, at the discretion of the user, be readily added, removed, or replaced, and that, when removed, will not prevent the fitting from fulfilling its primary function. For the purpose of this specification, an accessory can include, but is not limited to lavatory faucet flow restrictors, flow regulators, aerator devices, laminar devices, and pressure compensating devices.

[3] U.S. Census Bureau, American Housing Surveys for the United States, 1970-2003.

[4] Business Trend Analysts, 2006. "2005/2006 Outlook for the U.S. Plumbing Fixtures and Fittings Industry." <www.mindbranch.com/catalog/print_product_page.jsp?code=R225-358>

approximately 15.7 percent of indoor residential water use in the United States[5]—equivalent to more than 1.1 trillion gallons of water used each year.

The Energy Policy Act of 1992 originally set the maximum flow rate for both lavatory and kitchen faucets at 2.5 gallons per minute (gpm) at 80 pounds per square inch (psi) static pressure. In 1994, American Society of Mechanical Engineers (ASME) A112.18.1M-1994–Plumbing Supply Fittings set the maximum flow rate for lavatory faucets at 2.2 gpm at 60 psi. In response to industry requests for conformity with a single standard, in 1998, the U.S. Department of Energy adopted the 2.2 gpm at 60 psi maximum flow rate standard for all faucets (see 63 FR 13307; March 18, 1998). This national standard is codified in the *U.S. Code of Federal Regulations* at 10 *CFR* Part 430.32. As a point of reference, the maximum flow rates of many of the pre-1992 faucets range from 3 to 7 gpm. Other than the aforementioned maximum flow rate standards, there currently are no universally accepted performance tests or specifications (e.g., rinsing or wetting performance standards) for faucets.

III. WaterSense High-Efficiency Lavatory Faucet Specification

Scope

The WaterSense program developed this specification to address criteria for improvement and recognition of water-efficient and high-performance lavatory faucets and lavatory faucet accessories. WaterSense labeled lavatory faucet accessories can be incorporated into the design of new faucets to control the flow rate and provide the mechanism for meeting this specification's criteria, or can be purchased separately and retrofit onto existing older faucets to provide water efficiency and performance. This specification focuses solely on the category of lavatory faucets intended for private use because of the differences in the uses and performance expectations between private lavatory faucets and kitchen or public restroom faucets. Lavatory faucets are used primarily for hand washing and other sanitary activities, such as teeth brushing, face washing, and shaving. For these activities, discussions with faucet manufacturers and water utility representatives provided a general consensus that a reduction in the maximum flow rate from 2.2 gpm (the current federal water-efficiency standard) to 1.5 gpm, as established by this specification, is not very noticeable for most users. The most noticeable differences are increased wait times when filling the basin or waiting for hot water. While decreasing a faucet's maximum flow rate increases user wait time for these activities, WaterSense determined the potential water savings gained from the primary use of lavatory faucets (i.e., washing and rinsing) outweigh any potential inconvenience caused by increased wait times and will not negatively impact overall user satisfaction.

Kitchen sink faucets were excluded from this specification because the different uses and user expectations require other considerations for defining performance. One major performance consideration is a kitchen faucet's ability to effectively rinse dishes. Kitchen faucets also are commonly used for pot or container filling, and significantly increased wait times might not be acceptable to most users. WaterSense determined that reducing the maximum flow rates of kitchen faucets would create issues of user satisfaction and be counter to its program goals of

[5] Mayer, Peter W. and William B. DeOreo. Residential End Uses of Water. Aquacraft, Inc. Water Engineering and Management. American Water Works Association. 1998.

increasing efficiency while maintaining or improving performance. In order to maintain user satisfaction and ensure a high level of performance, a maximum flow rate greater than what is suitable for lavatory faucets might need to be considered for kitchen faucets. Some type of wetting or rinsing performance test also might need to be included. In addition, there is an emerging area of research and development in multiposition control lever faucet technologies that offer users “high” and “low” settings for different activities. While performance data are not yet available, these technologies might prove to be effective in using water more efficiently. For these reasons, WaterSense intends to evaluate the possibility of developing a WaterSense specification for kitchen faucets at a later date.

Public restroom and metering faucets (faucets that are set to discharge a specific amount of water or run for a specified period of time for each use) also were excluded from this specification because of their differing uses and performance expectations and because standards governing their maximum flow rate already exist. Public restroom faucets, for example, are used almost exclusively for hand washing or simple rinsing, compared to lavatory faucets in homes and in other private bathrooms that face a myriad of uses. As a consequence, the maximum flow rate for these public restroom and metering fixtures can be set significantly lower than the flow rate for private lavatory faucets without negatively impacting user satisfaction. Also, a separate set of standards already apply to these types of fixtures. Codified in the *U.S. Code of Federal Regulations* at 10 *CFR* Part 430 (specifically §430.32(o) Faucets) are standards setting the maximum flow rate for metering faucets at 0.25 gallons/cycle. Section 5.4.1 and Table 1 of ASME A112.18.1/CSA B125.1–Plumbing Supply Fittings also establish the maximum flow rates for public lavatory (other than metering) faucets at 0.5 gpm. As a consequence, this category of faucet is not covered by the current specification. If WaterSense decides to address water efficiency and performance for these types of faucets, it will do so under a separate specification at a later time.

Water-Efficiency and Performance Criteria

The water-efficiency component of this specification establishes a maximum flow rate of 1.5 gpm at an inlet pressure of 60 psi. Lowering the maximum flow rate from 2.2 gpm to 1.5 gpm (both at 60 psi) represents a 32 percent reduction, which is consistent with WaterSense’s stated goal of improving efficiency by at least 20 percent. Even when installed in systems with high water pressure (up to 80 psi), faucets designed to this specification will have maximum flow rates of approximately 1.75 gpm, which still represents a greater than 20 percent increase in efficiency. WaterSense chose to specify a test pressure of 60 psi to maintain consistency with the current industry standard (ASME A112.18.1–Plumbing Supply Fittings) to which all faucets sold in the United States must comply.

The requirements of this specification are also in harmony with other international standards. The Joint Standards Australia/Standards New Zealand Committee established standards for the rating and labeling of water-efficient products (AS/NZS 6400:2005). As part of the standard, water-efficient faucets are rated on a scale of 1 to 6 based on maximum flow rates. Under this system, comparable 1.5 gpm WaterSense labeled lavatory faucets would receive a 5 out of 6 star rating, meeting criteria for maximum flow rates between 4.5 liters per minute (L/min) (1.2 gpm) and 6.0 L/min (1.6 gpm).

Meeting or exceeding user expectations via the establishment of performance criteria for WaterSense labeled products is an important aspect of the WaterSense program. From the outset of discussions with interested parties, WaterSense was aware that performance of water-efficient lavatory faucets is affected by low water pressures. To ensure user satisfaction with WaterSense labeled lavatory faucets or lavatory faucet accessories across a range of possible user conditions, WaterSense has established a minimum flow rate of 0.8 gpm at 20 psi in the specification.

In developing these water-efficiency and performance criteria, WaterSense evaluated comments received during the draft specification's public forum and public comment period (see *Response to Issues Raised During Public Comment on February 2007 Draft Specification for WaterSense[SM] Labeling of High-Efficiency Lavatory Faucets*). WaterSense also considered user satisfaction data generated from four high-efficiency lavatory faucet retrofit studies and the impact of pressure changes on product flow rates for various types of lavatory faucet accessories.

WaterSense established a maximum flow rate of 1.5 gpm at 60 psi because interested parties that provided comments on the draft specification generally agreed that a flow rate of 1.5 gpm would provide no noticeable difference for most users. In addition, data collected from retrofit studies demonstrate a high level of user satisfaction with high-efficiency lavatory faucets that have maximum flow rates of 1.0 and 1.5 gpm. Aquacraft, Inc. conducted retrofit studies in Seattle, Washington (2000)[6] and East Bay Municipal Utility District (EBMUD), California (2003)[7] in which they replaced existing lavatory faucet aerators with 1.5 gpm pressure compensating aerators. In the Seattle study, 58 percent of the participants felt their faucets with the new aerators performed the same or better than their old faucet fixtures and 50 percent stated they would recommend these aerators to others. In the EBMUD study, 80 percent of the participants felt their faucets with the new aerators performed the same or better than their old faucet fixtures, and 67 percent stated they would recommend these aerators to others. A third Aquacraft, Inc. retrofit study conducted in Tampa, Florida (2004)[8] replaced existing lavatory faucet aerators with 1.0 gpm pressure compensating aerators. The participants in this study were receptive to an even higher-efficiency fixture, with 89 percent saying their new aerators performed the same or better than their old faucet fixtures and would recommend them to others. Seattle Public Utilities also provided WaterSense with survey results of customer use and satisfaction with 1.0 gpm pressure compensating aerators distributed through the utility's direct-mail showerhead and faucet aerator pilot program. According to its survey, 94 percent of the participants that received the free aerators installed them and only 2 percent disliked the aerators and removed them.[9]

[6] Seattle Home Water Conservation Study: The Impacts of High-Efficiency Plumbing Fixture Retrofits in Single-Family Homes, December 2000.

[7] Water Conservation Study: Evaluation of High-Efficiency Indoor Plumbing Fixture Retrofits in Single-Family Homes in the East Bay Municipal Utility District Service Area, July 2003.

[8] Tampa Water Department Residential Water Conservation Study: The Impacts of High-Efficiency Plumbing Fixture Retrofits in Single-Family Homes, January 2004.

[9] Seattle Public Utilities. "Showerhead/Aerator Pilot Program Summary." Unpublished.

WaterSense established a minimum flow rate of 0.8 gpm at 20 psi for several reasons. First, WaterSense felt this minimum flow rate was reasonable to ensure user satisfaction in homes with low water pressure based on comments that were received regarding the draft specification. Second, WaterSense received comments from several utilities regarding programs in which 1.0 gpm lavatory faucet aerators are provided to customers. These products have shown a high level of user satisfaction, and WaterSense wants to recognize these products and the efforts of the utilities to ensure that additional water savings can be achieved through such programs. Third, WaterSense wants to avoid restricting design options to the extent possible. The specification leaves open the possibility for the use of fixed orifice flow control devices (with a maximum flow rate of 1.5 gpm) instead of restricting manufacturers to the use of pressure compensating devices. Under the specification, a 1.5 gpm maximum flow rate fixed orifice aerator could qualify for use of the label (according to currently available product specifications and flow curves). Pressure compensating devices with maximum flow rates between 1.5 and 1.0 gpm could also qualify for the use of the WaterSense label (according to currently available product specifications and flow curves). WaterSense believes that this approach allows for the greatest degree of design freedom for manufacturers and supports existing utility programs, while still ensuring a high level of performance and user satisfaction.

In order for high-efficiency lavatory faucets to effectively emerge in the market following the release of the final version of this specification, the market must ideally be equipped to produce the faucets or faucet technology that the specification requires. WaterSense is not currently aware of any lavatory faucets on the market with a maximum flow rate of 1.5 gpm. There are, however, several types and models of faucet components and accessories currently available that have the capability to control the flow to the level that is required by this specification. As a result, WaterSense is confident that faucets and faucet accessories that meet the requirements of this specification can be readily brought to market.

Potential Water and Energy Savings

To estimate water and energy savings that can be achieved by products that meet this specification, WaterSense examined the Seattle (2000) and EBMUD (2003) Aquacraft retrofit studies, which provided actual water consumption reductions generated by the installation of high-efficiency, pressure-compensating 1.5 gpm aerators on lavatory faucets. WaterSense expects the results under this specification to be similar to what was found in these two studies. These studies indicate that installing high-efficiency aerators can yield significant reductions in household water consumption. Post faucet retrofit, the weighted average daily per capita reduction in water consumption achieved was 0.6 gallons per capita per day (gcpd). It is important to note that in both of these studies, kitchen faucets in each household were retrofitted with 2.2 gpm pressure compensating aerators. While these retrofits contributed in part to overall reductions in household water consumption, the retrofits simply brought those kitchen sink faucets up to current water-efficiency standards, therefore, WaterSense decided to set aside this confounding influence in order to estimate the water savings. Assuming the average household consists of 2.6 people, this equates to an average annual household savings of approximately 570 gallons of water (see Calculation 1).

Calculation 1. Average Household Water Savings
0.6 gpcd · 2.6 people/household · 365 days = 570 gallons annually

Extrapolated to the national level, potential estimated water savings could be as great as 61 billion gallons annually (see Calculation 2). These estimates clearly demonstrate the significant water savings potential of high-efficiency lavatory faucets and accessories.

Calculation 2. National Water Savings
570 gal/year · 107,574,000[10] occupied residences w/ plumbing fixtures = 61 billion gallons

Based upon these estimates, the average household could save more than 70 kWh of electricity (see Calculation 3) or 350 cubic feet of natural gas (see Calculation 4) each year. National savings could exceed 3 billion kWh hours and 20 billion cubic feet (Bcf) of natural gas each year (see Calculations 5 and 6).

Calculation 3. Electricity Saving Per Household
(570 gal/year · 0.70) · (176.5 kWh of electricity/1,000 gal) = 70 kWh of electricity per year

Calculation 4. Natural Gas Savings Per Household
(570 gal/year · 0.70) · (0.8784 Mcf of natural gas/1,000 gal) = 0.35 Mcf (350 cubic feet) of natural gas per year

Calculation 5. National Electricity Savings Potential
(61,000,000,000 gal · 0.70 · 0.40) · (176.5 kWh of electricity/1,000 gal) = 3 billion kWh of electricity nationwide

Calculation 6. National Natural Gas Savings Potential
(61,000,000,000 gal · 0.70 · 0.56) · (0.8784 Mcf of natural gas/1,000 gal) = 20 million Mcf of natural gas nationwide = 20 Bcf of natural gas nationwide

These calculations are based upon the following assumptions:

- Approximately 70 percent of faucet water used in a household is hot water (Tampa and Seattle Aquacraft studies).
- 42,788,000 (approximately 40 percent) of occupied residences in the United States heat their water using electricity.[11]
- 60,222,000 (approximately 56 percent) of occupied residences in the United States heat their water using natural gas.[12]

[10] U.S. Department of Housing and Urban Development and U.S. Census Bureau. American Housing Survey for the United States 2005. Table 1A-4 page 5.

[11] U.S. Department of Housing and Urban Development and U.S. Census Bureau. American Housing Survey for the United States 2005. Table 1A-5, page 6.

[12] U.S. Department of Housing and Urban Development and U.S. Census Bureau. American Housing Survey for the United States 2005. Table 1A-5, page 6.

- Water heating consumes 0.1765 kWh of electricity per gallon of water heated assuming:
  - Specific heat of water = 1.0 BTU/lb · º F
  - 1 gallon of water = 8.34 lbs
  - 1 kWh = 3,412 BTUs
  - Incoming water temperature is raised from 55º F to 120º F (Δ 65 º F).
  - Water heating process is 90 percent efficient, electric hot water heater.

Calculation 7.
[(1 gal · 1.0 BTU/lbs · º F) (1KWh/3,412 BTUs) / (1 gallon/8.34 lbs) · 65º F] / 0.90
= 0.1765 kWh/gal

- Water heating consumes 0.8784 Mcf of natural gas per 1,000 gallons of water heated assuming:
  - Specific heat of water = 1.0 BTU/lb · º F
  - 1 gallon of water = 8.34 lbs
  - 1 Therm = 99,976 BTUs
  - Incoming water temperature is raised from 55º F to 120º F (Δ 65 º F)
  - Water heating process is 60 percent efficient, natural gas hot water heater

Calculation 8.
[(1 gal · 1.0 BTU/lbs · º F) (1Therm/99,976 BTUs) / (1 gallon/8.34 lbs) · 65º F] / 0.60
= 0.009053 Therms/gal

Calculation 9.
0.010428 Therms/gal · 1,000 gal · 1Mcf/10.307 Therms = 0.8784 Mcf/kgal

Cost Effectiveness and Payback Period

The average homeowner retrofitting their lavatory faucets with WaterSense labeled high-efficiency lavatory faucet accessories (e.g., aerator, laminar flow device, flow restrictor) will realize accompanying $3.26 savings on water and wastewater cost annually due to lower water consumption (see Calculation 10).

Calculation 10. Annual Water and Wastewater Cost Savings
570 gallons/year · $5.72/1,000 gallons[13] = $3.26/year

Factoring in the accompanying energy savings, the average household with electric water heating may save an additional $6.65 (70 kWh/year · $.095/kWh), for a combined annual savings of $9.91. The average household with natural gas water heating, may save an additional $4.56.(0.35 Mcf/year · $13.04/Mcf), for a combined annual savings of $7.82.

[13] Raftelis Financial Consulting. Water and Wastewater Rate Survey. American Water Works Association. 2004.

Assuming that the average household has two lavatory faucets[14], replacing the aerators in each lavatory faucet with a WaterSense labeled aerator would save $1.63 per faucet on annual water and wastewater costs. The average payback period for the replacement of two lavatory faucet aerators would be approximately 10 months for those with electric water heating and 12 months for those heating with natural gas (See Calculations 11 and 12).

Calculation 11. Average Payback Period (Electric Water Heating)
$8.00 / [$3.26/year + (70 kWh/year · $.095/kWh)] = 0.8 years (~10 months)

Calculation 12. Average Payback Period (Natural Gas Water Heating)
$8.00 / [$3.26/year + (0.35 Mcf/year · $13.04 /Mcf)] = 1.0 years (~12 months)

These calculations are based upon the following assumptions:

- WaterSense labeled retrofit devices retail for $4.00 each.
- Average cost of electricity is $0.095/kWh[15].
- Average cost of natural gas is $13.04/Mcf[16].

Unit Abbreviations:
Bcf = billion cubic feet
BTU = British thermal unit
F = Fahrenheit
gal = gallon
gpcd = gallons per capita per day
gpm = gallons per minute
kgal = kilogallons
kWh = kilowatt hour
lbs = pounds
L/min = liters per minute
Mcf = thousand cubic feet
psi = pressure per square inch

WaterSense assumes that the cost of new faucets manufactured and sold as WaterSense labeled fixtures will not increase significantly since in many cases the manufacturer will simply need to substitute the current flow regulating device with a similar, more efficient rated device. In many cases this will be as simple as switching from the current 2.2 gpm aerator or laminar flow device to a comparable 1.5 gpm WaterSense labeled device

[14] U.S. Department of Housing and Urban Development and U.S. Census Bureau. American Housing Survey for the United States 2005. Table 1A-3 page 4.

[15] Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, Energy Information Administration. <www.eia.doe.gov/cneaf/electricity/epa/epat7p4.html>

[16] Short-Term Energy Outlook, Energy Information Administration. <www.eia.doe.gov/steo>

WaterSense® Specification for Showerheads

1.0 Scope and Objective

This specification establishes the criteria for showerheads labeled under the U.S. Environmental Protection Agency's (EPA's) WaterSense® program. It is applicable to showerhead fixture fittings, inclusive of:

- Fixed showerheads that direct water onto a user (excluding body sprays) for bathing purposes; and
- Hand-held showers, a subset of showerheads that are moveable devices for directing water onto a user. Hand-held showers can be installed on a support to function as a fixed showerhead.

When used in this document the term "showerhead" shall also include hand-held showers.

This specification is designed to ensure sustainable, efficient water use and a high level of user satisfaction with showerhead performance.

2.0 General Requirements

2.1 The showerhead shall conform to applicable requirements in ASME A112.18.1/CSA B125.1.[1]

2.2 If the showerhead has more than one mode, all modes must meet the maximum flow rate requirement outlined in Section 3.1.1 and at least one of the modes, as specified by the manufacturer, must meet all of the requirements outlined in this specification.

2.3 The showerhead shall not be packaged, marked, or provided with instructions directing the user to an alternative water-use setting that would override the maximum flow rate, as established by this specification. Any instruction related to the maintenance of the product, including changing or cleaning showerhead components, shall direct the user on how to return the product to its intended maximum flow rate.

3.0 Water-Efficiency Criteria

3.1 The flow rate of the showerhead shall be tested in accordance with the procedures in ASME A112.18.1/CSA B125.1 and shall meet the following criteria:

3.1.1 The manufacturer shall specify a maximum flow rate value (rated flow) of the showerhead. This specified value must be equal to or less than 2.0 gallons per minute (gpm) (7.6 liters per minute [L/min]).

[1] References to this and other standards apply to the most current version of those standards.

3.1.2 The maximum flow rate shall be the highest value obtained through testing at flowing pressures of 20, 45, and 80 ± 1 pounds per square inch (psi) (140, 310, and 550 ± 7 kilopascal [kPa]), when evaluated in accordance with 10 CFR 430 Subpart F, Appendix B, Step 6(b). This maximum flow rate shall not exceed the maximum flow rate value specified in Section 3.1.1.

3.1.3 The minimum flow rate, determined through testing at a flowing pressure of 20 ± 1 psi (140 ± 7 kPa) and when evaluated in accordance with 10 CFR 430 Subpart F, Appendix B, Step 6(a), shall not be less than 60 percent of the maximum flow rate value specified in Section 3.1.1.

3.1.4 The minimum flow rate shall be the lowest value obtained through testing at flowing pressures of 45 and 80 ± 1 psi (310 and 550 ± 7 kPa), when evaluated in accordance with 10 CFR 430 Subpart F, Appendix B, Step 6(a). This minimum flow rate shall not be less than 75 percent of the maximum flow rate value specified in Section 3.1.1.

4.0 Spray Force Criteria

4.1 The spray force of the showerhead shall be tested in accordance with the procedures outlined in Appendix A and shall meet the following criteria:

4.1.1 The minimum spray force shall not be less than 2.0 ounces (0.56 newtons [N]) at a pressure of 20 ± 1 psi (140 ± 7 kPa) at the inlet when water is flowing.

5.0 Spray Coverage Criteria

5.1 The spray coverage of the showerhead shall be tested in accordance with the procedures outlined in Appendix B and shall meet the following criteria:

5.1.1 The total combined maximum volume of water collected in the 2- and 4-inch [in.] (50-, 101-millimeter [mm]) annular rings shall not exceed 75 percent of the total volume of water collected, and;

5.1.2 The total combined minimum volume of water collected in the 2-, 4-, and 6-in. (50-, 101-, 152-mm) annular rings shall not be less than 25 percent of the total volume of water collected.

6.0 Marking

In addition to the marking requirements in ASME A112.18.1/CSA B125.1, the following markings shall apply:

6.1 The product shall be marked with the maximum flow rate value in gpm and L/min as specified by the manufacturer, verified through testing and in compliance with this specification.

6.2 The product packaging shall be marked with the maximum flow rate value in gpm and L/min as specified by the manufacturer, verified through testing and in compliance with this specification.

6.3 The product packaging shall be marked with the minimum flow rate value in gpm and L/min at 45 psi, calculated in Section 3.1.4 as 75 percent of the manufacturer's specified maximum flow rate value, verified through testing and in compliance with this specification.

6.4 Flow rate marking shall be in gpm and L/min in two or three digit resolutions (e.g., 2.0 gpm [7.6 L/min]).

7.0 Effective Date

This specification is effective on February 9, 2010.

8.0 Future Specification Revisions

EPA reserves the right to revise this specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. Revisions to the specification would be made following discussions with industry partners and other interested stakeholders.

9.0 Definitions

Definitions within ASME A112.18.1/CSA B125.1 are included by reference

ASME – American Society of Mechanical Engineers

ASME PTC – American Society of Mechanical Engineers Performance Test Codes

ANSI – American National Standards Institute

CFR – Code of Federal Regulations

CSA – Canadian Standards Association

ISA – International Society of Automation

WaterSense® Specification for Showerheads Supporting Statement

I. Introduction

Showering is one of the leading uses of water inside the home, representing approximately 17 percent of annual residential indoor water use in the United States. This translates into more than 1.2 trillion gallons of water consumed each year[1],[2]. The WaterSense program released its final specification for showerheads on March 4, 2010, to capitalize on this opportunity to further improve the nation's water and energy efficiency by raising consumer awareness and promoting the use of more efficient showerheads. The intent of this specification is to help consumers identify those products that have met EPA's criteria for water efficiency and performance.

WaterSense collaborated with the American Society of Mechanical Engineers (ASME)/Canadian Standards Association (CSA) Joint Harmonization Task Force to develop the specification criteria for high-efficiency showerheads. This task force is open to the public and comprises a wide variety of stakeholders, including showerhead manufacturers, water and energy utilities, testing laboratories, consultants, and other water-efficiency and conservation specialists. Their participation, resources, and expertise enabled WaterSense to evaluate showerhead efficiency and performance and develop meaningful testing protocols that can effectively differentiate showerhead performance.

Prior to the task force's work there were no universally accepted criteria for measuring showerhead performance. Federal water-efficiency legislation and national performance standards only establish product flow rates that dictate water consumption—they do not address what makes a satisfactory, or unsatisfactory, shower. Now, with this specification, WaterSense and the task force have bridged this consumer information gap by incorporating performance requirements for products seeking to earn the WaterSense label. The requirements address flow rates across a range of pressures, spray force, and spray coverage, three key attributes of showerhead performance, according to consumer testing. These new requirements are designed to ensure a high level of performance and user satisfaction with high-efficiency showerheads.

II. Current Status of Showerheads

With nearly 110 million occupied housing units in the United States[3] and an average of two showerheads per household[4], WaterSense estimates that there are 220 million showerheads

[1] Assumes a per capita shower use of 11.6 gallons. See Mayer, Peter W. and William B. DeOreo. *Residential End Uses of Water.* Aquacraft, Inc. Water Engineering and Management. American Water Works Association. 1998. Page 102.
[2] According to the U.S. Census Bureau, there are 300 million persons in the United States.
[3] See U.S. Census Bureau and the U.S. Department of Housing and Urban Development's *American Housing Survey for the United States*. 2007.
[4] Mayer and DeOreo, op. cit., 99.

currently installed in homes across the United States. WaterSense also estimates that approximately 10 percent of the existing 220 million showerheads are replaced each year due to wear, remodeling, or other reasons. This means that the vast majority of these existing showerheads have flow rates equal to or less than the federal standard of 2.5 gallons per minute (gpm), which was mandated by the Energy Policy Act (EPAct) of 1992. With normal replacements and units sold for new construction, WaterSense estimates that approximately 25.6 million[5] new showerheads are sold each year. Since Congress enacted the federal requirements in the early 1990s, manufacturers have gone on to develop showerheads that use significantly less water than the flow rates set in EPAct 1992. These high-efficiency showerheads can save at least 20 percent compared to standard fixtures, resulting in a potential savings of more than 1,200 gallons per showerhead per year.

III. WaterSense Specification for Showerheads

Scope

This specification applies to showerheads and hand-held showers. Showerheads are fixed devices for directing water onto a user for bathing purposes. Hand-held showers, a subset of showerheads, are moveable devices for directing water onto a user. Hand-held showers can be installed on a support to function as a showerhead.

Multiple showerheads are eligible to receive the WaterSense label provided the showerheads are sold in combination in a single device intended to be connected to a single shower outlet. Further, each showerhead must meet all of the requirements of the specification and the entire multiple-head system must meet the maximum flow rate requirement of the specification in all possible operating modes.

Body sprays are excluded from this specification because their function and design are wholly different than that of a showerhead or hand-held shower. Retrofit devices, including aftermarket flow control devices, are also excluded because the intent of the specification is to recognize and label complete, fully functioning fixtures or fittings, and not individual components.

General Requirements

Many showerheads are sold with multiple modes to provide the user with options for different spray types (e.g., misting, massaging, or pause). WaterSense wants to maintain manufacturing flexibility and consumer choice for multiple mode showerheads, thus the specification addresses these types of showerheads by requiring all modes to meet the maximum flow rate requirement (i.e., no mode can exceed 2.0 gallons per minute [gpm]) and at least one of the modes, as specified by the manufacturer, must meet all of the requirements contained in the specification, including the maximum and minimum flow rates, spray force, and spray coverage requirements.

Water-Efficiency Criteria

[5] Units sold for replacement is based upon a 10 percent natural replacement rate. Units sold for new construction is based on 1,797,000 new housing starts per year based on the average number of new housing starts from 2003–2007.from U.S. Census. 2007 American Housing Survey, Table 1A-1. www.census.gov/prod/2008pubs/h150-07.pdf.

The water-efficiency component of this specification establishes a maximum flow rate of 2.0 gpm (7.6 liter per minute [L/min]). WaterSense settled on this flow rate after examining the range of products currently available on the market. This maximum flow rate represents a 20 percent reduction from the current federally allowable maximum flow rate of 2.5 gpm established by EPAct 1992, which is consistent with WaterSense's stated water-efficiency goal.

The specification also includes minimum flow rate requirements at 80, 45, and 20 pounds per square inch (psi) of pressure (the upper, mid, and lower range of potential household pressures) to ensure performance and user satisfaction under a variety of household conditions. Specifically, at 45 and 80 psi the tested flow rate cannot be less than 75 percent of the showerhead's maximum "rated"[6] flow rate value. This minimum requirement is specified at both 45 and 80 psi because some showerheads that are designed to compensate and adjust for changes in water pressure will actually produce maximum flow at 45 psi and not at 80 psi. As a result, WaterSense wants to ensure that this minimum flow rate requirement is met at both pressures. Likewise, at 20 psi the tested flow rate cannot be less than 60 percent of the showerhead's maximum rated flow rate value. Table 1 below provides some examples of the allowable minimum flow rates for showerheads with various rated flow rates. Defining minimum flow rate requirements in this manner ensures that the showerhead is designed to provide consistent flow across a range of pressures.

Table 1. Example Minimum Flow Rates

Showerhead Rated Flow Rate	Minimum Allowable Flow Rate		
	80 psi	45 psi	20 psi
2.0 gpm	1.5 gpm	1.5 gpm	1.2 gpm
1.75 gpm	1.3 gpm	1.3 gpm	1.1 gpm
1.5 gpm	1.1 gpm	1.1 gpm	0.9 gpm
1.0 gpm	0.8 gpm	0.8 gpm	0.6 gpm

WaterSense is requiring both the maximum and minimum flow rates of the showerhead to meet the testing and verification protocols for sampling outlined in the *Code of Federal Regulations* (see 10 CFR 430 Subpart F, Appendix B, Steps 6[b] and 6[a], respectively). The U.S. Department of Energy currently uses the sampling plan outlined in the CFR for assessing compliance of showerhead flow rates with EPAct 1992 requirements, and thus referencing it in this specification provides specific and familiar guidance to third-party certifying bodies for determining whether a showerhead meets the flow rate requirements established by WaterSense.

Performance Criteria

Establishing performance-based criteria for WaterSense labeled showerheads is critical to ensuring user satisfaction and maintaining the integrity of the WaterSense label. Prior to this specification, however, there were no universally agreed-upon testing protocols for showerhead performance or measures that adequately defined user satisfaction. WaterSense worked with

[6] The "rated" flow rate is the showerhead's maximum flow rate, as specified by the manufacturer, verified through testing, and in compliance with this specification.

the task force to determine, through its expertise and supported by consumer testing, the key performance attributes of showerheads.

To measure those attributes in a laboratory setting, the task force undertook an intensive effort to develop test protocols. The spray force and spray coverage requirements contained in the specification are a result of these efforts. Both test protocols subsequently underwent several iterations of round robin testing in various laboratories by multiple manufacturers and independent third-party certifiers in order to ensure that the procedures are repeatable and the results reproducible. Laboratory test data were then compared back to the consumer test data for a variety of showerheads to determine the specific performance levels that are included in the specification. These performance levels define the boundaries for user satisfaction for both spray force and spray coverage.

The spray force component of the specification requires a showerhead's spray force to be at least 2.0 ounces (0.56 newtons [N]) at an inlet pressure of 20 psi when the water is flowing. The testing procedure, described in Appendix A of the specification, is a pass/fail test that assesses the relative force of the shower spray through the use of a force balance fixture. The force balance fixture is equipped with a force target on one side that receives the shower spray and counterbalancing weights on the other side, set to the specified force (i.e., 2.0 ounces). As the shower spray hits the force target, the force balance fixture measures the rotation angle of the balance at the pivot point of the two sides (the spray and counterbalancing weights).

If the shower spray force is greater than the specified minimum, it will overcome, or move, the counterbalancing weights to or beyond the point of balance, achieved when the angle rotates within 0.1^{o} of zero or past it. Under this scenario the showerhead would pass the force requirements. If the showerhead's force is less than the specified minimum, it will not overcome the counterbalancing weights and the angle of balance will not rotate within 0.1^{o} of zero or past it. Under this scenario, the showerhead would fail the force requirements. The target force of 2.0 ounces specified in the specification represents the lower bounds of user satisfaction based on results from consumer tests using a variety of showerheads.

The spray coverage component of the specification, as described in Appendix B of the specification, requires the use of an annular ring gauge consisting of a series of concentric rings, starting with a 2-inch diameter center ring and each successive ring increasing in diameter by 2 inches out to 20 inches. The showerhead is positioned and turned on directly above the surface of the annular ring gauge. The relative amount of water captured in each set of concentric rings provides a representation of the distribution of the spray pattern and can be used to evaluate the showerhead's spray coverage.

Simultaneous to the development of the test apparatus, WaterSense gathered consumer test data to determine user preferences with respect to spray coverage. Data showed general dissatisfaction with showerheads that spray with a hollow spot in the center or that have too much water flowing in the center to form a very narrow beam. Thus the criteria contained in the specification were crafted to capture and disqualify showerheads with these types of coverage characteristics. Specifically, to meet the spray coverage requirement, the total volume of water collected in the two center rings (out to 4 inches) cannot exceed 75 percent of the total collected water volume (i.e., the showerhead cannot deliver all its water through a narrow beam in the center). In addition, the total combined volume of water collected in the three center rings (out to

6 inches) must be at least 25 percent of the total collected water volume (i.e., the showerhead cannot have a hollow spot in the center).

Marking

With this specification, WaterSense has adopted a new approach to product and package flow rate marking. The requirements are designed to clarify and clearly indicate which maximum flow rate value the manufacturer is to use. At the outset of certification, the manufacturer specifies a maximum flow rate value ("rated" flow rate), not to exceed 2.0 gpm, which is subsequently verified through testing. WaterSense requires the manufacturer to mark the product and product packaging with this rated flow rate value, so that the information provided to the consumer is both informative and accurate.

In addition to marking the product and packaging with the maximum rated flow rate, the product packaging (but not the product itself) must also be marked with the showerhead's minimum flow rate at 45 psi. This minimum flow rate is calculated as 75 percent of the manufacturer's specified maximum flow rate value and is subsequently verified through testing. The purpose of this marking requirement is to assist installers in properly matching showerheads and automatic-compensating mixing valves for installation in order to provide protection against thermal shock and scalding events (see Section V below for more information).

Potential Water and Energy Savings

Note: Refer to Appendix A for the assumptions and calculations used to derive these estimates.

Showerheads with a flow rate of 2.0 gpm or less have the potential to save significant amounts of water both individually and at the national level. Replacing standard showerheads with WaterSense labeled showerheads could save more than 1,200 gallons per showerhead or 2,300 gallons of water per household per year. Based upon the amount of water saved, the average household could save 300 kilowatt hours (kWh) of electricity or 1,500 cubic feet of natural gas that would otherwise be required to heat the water.

Nationwide, if WaterSense labeled showerheads were purchased for all normal showerhead replacements and installed in all new construction, WaterSense estimates that water savings could reach 30.3 billion gallons per year. National energy savings could exceed 1.6 billion kWh of electricity and 10.9 million cubic feet (Mcf) of natural gas each year.

Cost-Effectiveness

Note: Refer to Appendix A for the assumptions and calculations used to derive these estimates.

The average homeowner retrofitting his or her showerheads with WaterSense labeled showerheads will realize an accompanying $14 savings on water and wastewater costs annually due to lower water consumption. Factoring in the accompanying energy savings, the average household with electric water heating may save an additional $36, for a combined annual savings of $50. The average household with natural gas water heating may save an additional $18 for a combined annual savings of $32.

If the average showerhead costs $30 retail, the average payback period for the replacement of two standard showerheads per household with WaterSense labeled models would be approximately 14 months for those with electric water heating and about two years for those heating with natural gas.

IV. Certification and Labeling

WaterSense has established an independent third-party product certification process, described on the WaterSense Web site at www.epa.gov/watersense/partners/certification.html. Under this process, products are certified to conform to applicable WaterSense specifications by accredited third-party licensed certifying bodies. Manufacturers are then authorized to use the WaterSense label in conjunction with certified products.

V. Other Issues

Detailed Drawings for the Force Balance Test Apparatus

As the specification indicates, the spray force performance requirement is measured via a force balance test apparatus. This force balance test apparatus was developed by the task force specifically for the purpose of determining a showerhead's compliance with the specification's force requirements; therefore it is not a readily available or mass-produced piece of testing equipment. In addition, the test apparatus needs to be manufactured with very specific tolerances to ensure the results are repeatable and reproducible in any laboratory setting. WaterSense has made available the specification drawings to facilitate the construction of this test equipment. Detailed drawings for the force balance test apparatus are available on the WaterSense Web site at www.epa.gov/watersense/products/showerheads.html.

Health and Safety

In developing this specification, WaterSense and the task force considered potential negative impacts of reducing the flow rate on consumer satisfaction, including potential health and safety issues once these products are installed in the plumbing system. Of particular concern is the potential for increasing the risk of thermal shock or scalding as shower flow rates are reduced. Thermal shock or scalding can be caused when a hot- or cold-water-using device is activated (e.g., flushing the toilet or running the dishwasher) while the shower is running. Water is diverted away from the shower, causing a pressure drop in either the hot or cold water supply line to the shower. As a consequence, the balance of hot and cold water is shifted either to a hotter or colder temperature mix. This sudden change in temperature can either cause a user to abruptly move away from the shower stream, potentially resulting in an injury or fall, or if the temperature increase is severe enough, scalding can occur.

To mitigate the risks of temperature-related shower injuries, most U.S. plumbing codes require showers to be outfitted with individual automatic-compensating mixing valves that comply with either the American Society of Sanitary Engineers (ASSE) 1016 or ASME A112.18.1/CSA B125.1 standards. An automatic-compensating mixing valve is a device that is installed as part of the shower's flow control that helps to regulate water temperature; it is not part of the showerhead itself. The valve works either through balancing the incoming hot and cold water

pressures or through controlling the mixed outlet temperature with a thermostatic element that can maintain water temperature to within +/- 3.6°F.

Despite advances in plumbing codes and mixing valve technology, thermal shock and scalding risks are still present under two scenarios. First, automatic-compensating mixing valves are currently only required to be tested and certified at a flow rate of 2.5 gpm at 45 psi. When these devices are outfitted with a showerhead that has a lower flow rate, there may not be adequate assurance that the valve is sensitive enough to provide the required protection. This is potentially true for all showerheads, as standard showerheads are currently tested and certified at a flow rate of 2.5 gpm at 80 psi. Second, not all homes are equipped with an automatic-compensating mixing valve. The risks are of particular concern for showerhead retrofits in homes built prior to 1987.

As a part of the development of the criteria for showerheads, WaterSense and the task force evaluated the link between flow rate and temperature deviations associated with pressure and temperature changes. The task force gathered and presented data to compare the temperature profiles that result from a drop in hot and cold water pressure for both standard and high-efficiency showerheads under the two risk scenarios: (1) installation with various types of automatic-compensating mixing valves (thermostatic, pressure balancing, or combination) designed for a flow rate of 2.5 gpm at 45 psi and (2) installation without the protection of an automatic-compensating mixing valve. The data showed that the risks are present for showerheads of all flow rates, but that more efficient showerheads are more sensitive to sudden changes in water pressure. As a consequence, a temperature change in water exiting the shower may be amplified when the pressure within the cold water or hot water supply plumbing suddenly changes.

Ultimately, WaterSense and the task force came to the conclusion that the thermal shock and scalding risks cannot be fully addressed through the specification for showerheads. First, there is a clear disconnect between the showerhead and automatic-compensating mixing valve compatibility, as the products are tested at different pressures (80 psi and 45 psi, respectively) and currently automatic-compensating mixing valves are only tested at a flow rate of 2.5 gpm. Second, the potential temperature of the hot water is controlled by the design of the hot water heater and delivery system, which can discharge water well in excess of the code required 140°F due to “layering” and the location of the thermostat at a point that is not necessarily the location of the hottest water. Because of the interrelated nature of these three components in the plumbing system, the control of the risks cannot solely rest on the design of the showerhead. In fact, the showerhead itself has very little, if any, control over the outlet water temperature.

To the extent possible, WaterSense has addressed this issue in the specification by requiring manufacturers to mark the product packaging with the minimum flow rate at 45 psi as determined by testing at that pressure. This is a vital step toward providing the information necessary to "match" the showerhead with a compatible automatic-compensating mixing valve that is rated to perform at the same flow rate and tested pressure. In addition, industry is currently working to harmonize automatic-compensating mixing valve standards and showerhead standards to address potential incompatibilities of these plumbing system components. This will go a long way toward addressing the risks of thermal shock and scalding associated with the installation of a WaterSense labeled showerhead, indeed with all

showerheads, particularly in new construction. WaterSense is also educating consumers and program partners regarding the issue and associated risks so that consumers can continue to make informed purchasing decisions.

Appendix A: Calculations and Key Assumptions

Potential Water Savings Calculations

Assumptions:

- Average actual flow rate for an existing showerhead is 2.22 gpm[7] (the average flow rate is less than the standard rated flow rate of 2.5 gpm most likely because the products are rated at 80 psi, but installed in homes with less pressure)
- Average shower duration is 8.2 minutes[11]
- The average person takes 0.67 showers per day[8]
- A WaterSense labeled showerhead reduces the flow rate by 20 percent
- An estimated 10 percent of existing showerheads are replaced each year due to wear, remodeling, or other reasons
- There are an estimated 1,797,000 new housing starts per year based on the average number of new housing starts from 2003–2007[9]

Equation 1. Annual Water Savings Potential from Replacing a 2.5 gpm Rated Showerhead

(((2.22 gpm – (2.22 gpm x (1-0.2))) x 8.2 minutes/shower x 0.67 showers/person/day x 2.6 people/household x 365 days/year) = 2,300 gal/household/year

(2,300 gal/household/year / 2 showerheads/household) = 1,200 gal/showerhead/year

Equation 2. Annual National Water Savings Potential from Replacing All Existing 2.5 gpm Showerheads

(1,200 gal/showerhead/year x 220 million existing showerheads) = 260 billion gal/year

Equation 3. Annual National Water Savings Potential from Natural Replacement with WaterSense Labeled Showerheads

(1,200 gal/showerhead/year x 220 million showerheads * 0.10) = 26 billion gal/year

Equation 4. Annual National Water Savings Potential from Installation of WaterSense Labeled Showerheads in New Construction

(1,200 gal/showerhead/year x 1,797,000 annual new housing starts x 2 showerheads/household) = 4.3 billion gal/year

Unit Abbreviations:
gal = gallon
gpm = gallons per minute
psi = pressure per square inch

Potential Energy Savings Calculations

[7] Mayer and DeOreo, Op. cit., 102.
[8] Calculated based upon an assumed 17.2 gallons per shower and 11.6 gallons per day for showering. (Ibid.)
[9] U.S. Census. 2007 American Housing Survey, Table 1A-1. www.census.gov/prod/2008pubs/h150-07.pdf.

Assumptions:

- Approximately 73 percent of showerhead water used in a household is hot water[10]
- 42,239,000 (approximately 40 percent) of occupied residences in the United States heat their water using electricity[11]
- 60,998,000 (approximately 56 percent) of occupied residences in the United States heat their water using natural gas[11,12]
- Water heating consumes 0.18 kWh of electricity per gallon of water heated assuming:
  - Specific heat of water = 1.0 Btu/lb x º F
  - 1 gallon of water = 8.34 lbs
  - 1 kWh = 3,412 Btus
  - Incoming water temperature is raised from 55º F to 120º F (Δ 65 º F)
  - Water heating process is 90 percent efficient for electric hot water heaters
- Water heating consumes 0.88 Mcf of natural gas per 1,000 gallons of water heated assuming:
  - Specific heat of water = 1.0 Btu/lb x º F
  - 1 gallon of water = 8.34 lbs
  - 1 Therm = 99,976 Btus
  - Incoming water temperature is raised from 55º F to 120º F (Δ 65 º F)
  - Water heating process is 60 percent efficient for natural gas hot water heaters

Electricity

Equation 5. KWh Required to Raise 1 Gallon of Water 65º F

[(1.0 Btu/lbs x º F) (1kWh/3,412 Btus) / (1 gal/8.34 lbs) x 65º F] / 0.90 = 0.18 kWh/gal

Equation 6. Electricity Saving Potential per Household

(2,300 gal/year x 0.73) x (180 kWh of electricity/1,000 gal) = 300 kWh of electricity per year

Equation 7. National Electricity Savings Potential from Replacing All Existing 2.5 gpm Showerheads

(260 billion gal/year x 0.73 x 0.40) x (180 kWh of electricity/1,000 gal) = 14 billion kWh of electricity nationwide

Equation 8. National Electricity Savings Potential from Natural Replacement with WaterSense Labeled Showerheads

(26 billion gal/year x 0.73 x 0.40) x (180 kWh of electricity/1,000 gal) = 1.4 billion kWh of electricity nationwide

Equation 9. National Electricity Savings Potential from Installation of WaterSense Labeled Showerheads in New Construction

[10] DeOreo, William B., and Peter W. Mayer. *The End Uses of Hot Water in Single Family Homes From Flow Trace Analysis*. 2000. Aquacraft, Inc.
[11] U.S. Department of Housing and Urban Development and U.S. Census Bureau. *American Housing Survey for the United States: 2007*. 2008. Table 1A-5, page 7.
[12] Ibid.

(4.3 billion gal/year x 0.73 x 0.40) x (180 kWh of electricity/1,000 gal) = 230 million kWh of electricity nationwide

Natural Gas

Equation 9. Therms Required to Raise 1 Gallon of Water 65º F
[(1.0 Btu/lbs x º F) (1 Therm/99,976 Btus) / (1 gal/8.34 lbs) x 65º F] / 0.60 = 0.009 Therms/gal

Equation 10. Converting Therms to Mcf
0.009 Therms/gal x 1,000 gal/kgal x 1 Mcf/10.307 Therms = 0.88 Mcf/kgal

Equation 11. Natural Gas Savings Potential per Household
(2,300 gal/year x 0.73) x (0.88 Mcf of natural gas/1,000 gal) = 1.5 Mcf (1,500 cubic feet) of natural gas per year

Equation 12. National Natural Gas Savings Potential from Replacing All 2.5 gpm Showerheads
(260 billion gal x 0.73 x 0.56) x (0.88 Mcf of natural gas/1,000 gal) = 94 million Mcf of natural gas nationwide

Equation 13. National Natural Gas Savings Potential from Natural Replacement with WaterSense Labeled Showerheads
(26 billion gal x 0.73 x 0.56) x (0.88 Mcf of natural gas/1,000 gal) = 9.4 million Mcf of natural gas nationwide

Equation 14. National Natural Gas Savings Potential from Installation of WaterSense Labeled Showerheads in New Construction
(4.3 billion gal/year x 0.73 x 0.56) x (0.88 Mcf of natural gas/1,000 gal) = 1.5 million Mcf of natural gas nationwide

Unit Abbreviations:
Bcf = billion cubic feet
Btu = British thermal unit
F = Fahrenheit
kgal = kilogallons
kWh = kilowatt hour
lbs = pounds
Mcf = thousand cubic feet

Cost-Effectiveness Calculations

Assumptions:
- Price of water and wastewater is $6.06/1000 gallons[13]
- 2009 Price of electricity is $0.12/kWh[14]
- 2009 Price of natural gas is $11.98/Mcf[15]

[13] Raftelis Financial Consulting. *Water and Wastewater Rate Survey*. American Water Works Association. 2006.
[14] U.S. Department of Energy, www.eia.doe.gov/cneaf/electricity/epm/table5_3.html.

Equation 15. Annual Household Water and Wastewater Cost Savings
2,300 gallons/year x $6.06/1,000 gallons = $14/year

Equation 16. Annual Household Electricity Savings
(300 kWh/household/year * $0.12/kWh) = $36/year

Equation 17. Annual Household Natural Gas Savings
(1.5 Mcf/household/year * $11.98/Mcf) = $18/year

Equation 18. Annual Water, Wastewater, and Electricity Savings
($14/year + $36/year) = $50/year

Equation 19. Annual Water, Wastewater, and Natural Gas Savings
($14/year + $18/year) = $32/year

Equation 11. Average Full Payback Period (Electric Water Heating)
($30/showerhead x 2 showerheads/household) / $50/year = 1.2 years (~14 months)

Equation 12. Average Full Payback Period (Natural Gas Water Heating)
($30/showerhead x 2 showerheads/household) / $32/year = 1.9 years (~ 23 months)

[15] U.S. Department of Energy, www.eia.doe.gov/steo.

WaterSense® Specification for Tank-Type Toilets

Version 1.2

June 2, 2014

WaterSense® Specification for Tank-Type Toilets

1.0 Scope and Objective

This specification establishes the criteria for a tank-type high-efficiency toilet under the U.S. Environmental Protection Agency's (EPA's) WaterSense program. It is applicable to:

- Single-flush, tank-type gravity toilets
- Dual-flush, tank-type gravity toilets
- Dual-flush, tank-type flushometer tank (pressure-assist) toilets
- Tank-type, flushometer tank (pressure-assist) toilets
- Tank-type electrohydraulic toilets
- Any other tank-type technologies that meet these performance specifications

The specification is designed to ensure both sustainable, efficient water use and a high level of user satisfaction with flushing performance.

2.0 General Requirements

2.1 The toilet shall conform to applicable water closet requirements in ASME A112.19.2/CSA B45.1,[1] except as otherwise indicated in this specification.

2.2 If the toilet has dual-flush capabilities, it shall conform to requirements in ASME A112.19.14.

3.0 Water Efficiency Criteria

3.1 Single-flush toilets: The effective flush volume shall not exceed 1.28 gallons (4.8 liters) when evaluated in accordance with the sampling plan contained in 10 CFR 429.30. For single-flush toilets, the effective flush volume is the average flush volume when tested in accordance with ASME A112.19.2/CSA B45.1.

3.2 Dual-flush toilets: The effective flush volume shall not exceed 1.28 gallons (4.8 liters) when evaluated in accordance with the sampling plan contained in 10 CFR 429.30. For dual-flush toilets, the effective flush volume is the average flush volume of two reduced flushes and one full flush. Flush volumes shall be tested in accordance with ASME A112.19.2/CSA B45.1 and ASME A112.19.14.

3.3 Samples with average flush volume in excess of 0.10 gallon (0.4 liter) greater than their rated flush volume shall be deemed to fail testing requirements due to excessive flush volume.[2]

[1] References to this and other standards apply to the most current version of that standard.
[2] For example, fixtures rated at 1.28 gallons per flush (the maximum flush volume) but flushing at greater than 1.38 gallons (5.2 liter) when adjusted in accordance with the water consumption test procedure in ASME A112.19.2/CSA B45.1 shall be deemed to have "failed" the requirements of this specification.

3.4 Samples with average flush volumes less than or equal to 0.10 gallon (0.4 liter) greater than their rated flush volume shall be adjusted, if possible, to their rated flush volume prior to performance testing.

3.5 Samples with average flush volumes less than their rated flush volume shall be tested at measured volume and this volume shall be recorded on the test report.

4.0 Flush Performance Criteria

4.1 Toilet model performance is identified as either a "pass" or "fail" depending upon whether it can successfully and completely clear all test media from the fixture in a single flush in at least four of five attempts. Flush performance testing shall be conducted in accordance with the waste extraction test protocol provided in ASME A112.19.2/CSA B45.1.

5.0 Product Marking

5.1 Toilet fixtures shall be marked in accordance with requirements in ASME A112.19.2/CSA B45.1 with the exception identified in Section 5.1.1 below.

5.1.1 Toilet bowls intended to be used with tanks of varying consumption levels (e.g., 1.6 and 1.28 gallons per flush) shall be marked with a dual consumption marking or a consumption range, as indicated in ASME A112.19.2/CSA B45.1; however, toilet bowls shall not be marked with the words "or less" to indicate compatibility with tanks of varying consumption levels.

5.2 Toilet tanks shall not be packaged, marked, nor provided with instructions directing the user to an alternative water use setting that would override the rated flush volume, as established by this specification. Any instruction related to the maintenance of the product shall direct the user on how to return the product to its rated flush volume.

6.0 Effective Date

This specification is effective on June 2, 2014.

7.0 Future Specification Revisions

EPA reserves the right to revise this specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. Revisions to the specification would be made following discussions with industry partners and other interested stakeholders.

8.0 Definitions

Definitions within ASME A112.19.2/CSA B45.1 and ASME A112.19.14 are included by reference.

- **Pressure-assist toilet:** A water closet that uses a flushometer tank as a flushing device, as defined in ASME A112.19.2/CSA B45.1.

- **Rated flush volume:** The maximum flush volume, as specified by the manufacturer, verified through testing and in compliance with this specification.

Appendix A: Requirements for WaterSense Labeling

The following requirements must be met for products to be bear the WaterSense label.

1.0 WaterSense Partnership

The manufacturer[3] of the product must have a signed partnership agreement in place with EPA.

2.0 Conformity Assessment

Conformance to this specification must be certified by an EPA licensed certifying body accredited for this specification in accordance with the *WaterSense Product Certification System*.

3.0 Clarifications

3.1 Adjustability

Toilet tanks with adjustable water use settings that can be identified and activated by a user or plumbing professional to override the rated flush volume, as established by this specification, do not comply with the intent of this specification or the WaterSense program and do not qualify for use of the WaterSense label.

3.2 Tanks and Bowls Manufactured and Sold by Different Companies

WaterSense requires every combination tank and bowl to be tested and certified for conformance to this specification in order to ensure that the toilet as a whole provides the expected water efficiency and performance. Wall-hung bowls and in-wall carrier systems manufactured and sold by different companies can earn the WaterSense label, provided that the combination unit is tested and certified. However, since these products might not necessarily be sold as a unit, WaterSense has established some additional certification requirements that these products must meet in order to earn the WaterSense label. Both manufacturers must agree to have their products tested and certified together in order for the tank and bowl combination to receive the WaterSense label.

Certification Listing

In order to control the use of the WaterSense label, EPA is requiring each manufacturer (e.g., the tank manufacturer and the bowl manufacturer) to obtain a certification listing with one of EPA's licensed certifying bodies to show that the toilet, formed by the combination tank and bowl, was certified for conformance to the specification. The listings must identify both components, along with the respective manufacturers' names,

[3] Manufacturer, as defined in the WaterSense program guidelines, means: "Any organization that produces a product for market that might be eligible to meet WaterSense criteria for efficiency and performance. Manufacturers can also produce 'private label' products that are sold under the brand name of a separate organization, which is treated as a separate partner/application from the original product manufacturer." In the case of private labeling, the private labeling organization that ultimately brands the product for sale must have a signed WaterSense partnership agreement in place with EPA.

brand names, model names, and model numbers by which the products are identified and sold. Separate listings will allow the licensed certifying body to directly authorize each manufacturer to use the WaterSense label on their tanks or bowls. Note that though a certification listing is required for each manufacturer, WaterSense is not requiring the combination toilet to be tested more than once. The licensed certifying body must ensure that the listing information is complete prior to issuing the certification and the WaterSense label to either manufacturer.

As an alternative to separate listings, and at the discretion of the licensed certifying body, the manufacturer of one of the components (e.g., either the tank or bowl manufacturer) can become listed as an additional company under the certification listing of the manufacturer of the corresponding component (e.g., the bowl or tank). However, both components, along with the respective manufacturer's names, brand names, model names, and model numbers by which the products are identified and sold, must be identified under both the certification file owner's listing and the additional company's listing. This will ensure that there is no confusion about which products were certified in combination to earn the WaterSense label.

3.3 Product Packaging Marking and Labeling

Though every combination tank and bowl must be tested and certified for conformance to this specification in order to ensure that the toilet as a whole provides the expected water efficiency and performance, in some cases the tank and bowl might be packaged individually and/or sold separately. To ensure that it is clear to the purchaser that a particular combination tank and bowl is labeled, EPA is providing clarification regarding how the packaging must be marked and how the WaterSense label must be used. These marking and labeling requirements apply to tanks and bowls made by the same company and those made by different companies, as is the case for some wall-hung bowls and in-wall carrier systems.

Manufacturers must adhere to the following product packaging marking and labeling requirements for toilet tanks and bowls packaged and sold individually:

- In all cases, the toilet tank and toilet bowl packaging must bear the WaterSense label.
- Toilet bowl packaging must indicate all of the specific brand names, model names, and model numbers, as applicable, of the counterpart tanks it can be used with to form a WaterSense labeled tank-type toilet. For example, the toilet bowl packaging might say:

  > "This [insert description of bowl] is WaterSense labeled when used with [list brand names, model names, and model numbers, as applicable, of the tank(s) that the bowl can be used with to form a WaterSense labeled tank-type toilet]."

- Product specification sheets or other product documentation for both the toilet tank and bowl must indicate all of the specific brand names, model names, and model numbers, as applicable, of the counterpart products (e.g., the bowl or tank) that the product can be used with to form a WaterSense labeled tank-type toilet.

Note that for toilet tanks and bowls packaged and sold together as a unit, the packaging must bear the WaterSense label.

Summary of Revisions to the WaterSense® Specification for Tank-Type Toilets Version 1.2

The U.S. Environmental Protection Agency's (EPA's) WaterSense program is announcing the release of Version 1.2 of its *WaterSense Specification for Tank-Type Toilets* (specification). The purpose of this document is to summarize the revisions made to the specification, share the reasoning for the changes, and provide a timeline for compliance with the new requirements.

It is important to note that EPA considers the revisions made in Version 1.2 of the specification to be minor in nature. The revisions are meant to provide clarification of the existing requirements and do not materially affect the scope, performance, or efficiency requirements. The revisions also do not affect the status of existing certified, WaterSense labeled tank-type toilets.

Background

WaterSense released its initial *Tank-Type High-Efficiency Toilet Specification* in January 2007 and issued the first revision to the specification in May 2011. Since that time, the American Society of Mechanical Engineers (ASME) and Canadian Standards Association (CSA) have revised ASME A112.19.2/CSA B45.1 *Ceramic Plumbing Fixtures* to include the waste media extraction test, fill valve integrity test, and tank trim adjustability test protocols established in the *WaterSense Specification for Tank-Type Toilets*. To align with the revised ASME A112.19.2/CSA B45.1 standard, to the extent possible, WaterSense is issuing Version 1.2 of the specification. The changes to the specification, described in this document, will ensure consistency and reduce redundancy in toilet testing for manufacturers seeking the WaterSense label. WaterSense has also taken this opportunity to make some additional minor revisions to the specification to align it with the other WaterSense product specifications. All of the revisions contained in Version 1.2 will ensure that tank-type toilets receiving the WaterSense label are certified and labeled consistently, in accordance with EPA's intent, and will continue to meet consumer expectations for efficiency and performance.

Section 2.0 General Requirements

EPA has revised the title of the section from "Summary of Criteria" to "General Requirements." This change does not affect the specification's original scope of objective, but rather aligns the organization of the specification with other WaterSense product specifications.

Similarly, to align with other WaterSense product specifications, EPA has revised the content of Section 2.0 to provide the general and overarching requirements that products must meet to earn the WaterSense label, rather than a summary of the specification requirements. This section now indicates that all tank-type toilets shall conform to the applicable water closet requirements in ASME A112.19.2/CSA B45.1, and all dual-flush tank-type toilets must conform to applicable requirements within ASME A112.19.14 *Six-Liter Water Closets Equipped With a*

Dual Flushing Device. This change now more fully and clearly aligns the specification with the requirements of the guiding national standards for tank-type toilets.

Section 3.0 Water Efficiency Criteria

Flush Volume Measurement Requirements

The majority of the fixture performance testing protocol, originally provided in Appendix A of the specification, is included in the recent revisions to the ASME A112.19.2/CSA B45.1 standard. The fixture performance testing protocol is now incorporated by reference in Section 2.0 of the specification. However, the ASME/CSA standard does not address the average flush volume limits that dictate whether a toilet is deemed to pass or fail the flush volume test or whether the flush volume should be adjusted to complete the test. As a result, WaterSense has retained these requirements in the specification. As discussed below, Appendix A was removed from the specification because a majority of the requirements are now redundant with the A112.19.2/CSA B45.1 standard; therefore, WaterSense moved these flush volume limit requirements to *Section 3.0 Water Efficiency Criteria*. This change does not affect the specification's original requirements or intent.

Section 4.0 Flush Performance Criteria

Testing Protocol Reference

In Version 1.1 of the specification, the fixture performance testing protocol was identified in Appendix A. Since the protocol is now included in the recent revisions to the ASME A112.19.2/CSA B45.1 standard, WaterSense has updated *Section 4.0 Flush Performance Criteria* to reference compliance with the standard rather than Appendix A (Appendix A has been subsequently deleted). In addition, under Version 1.1, this section summarized the test media requirements. It also stipulated that the protocol was only applicable to single-flush toilets and to the full flush option of dual-flush toilets. These requirements are also covered in the referenced standards and, therefore, WaterSense removed them from this section to minimize redundancy.

In addition, in the development of the revised ASME A112.19.2/CSA B45.1 standard, there was consensus that the casing used for the test media did not materially affect the results of the test. Either cased or uncased media were deemed acceptable for performance testing. In view of this decision and because of the desire for the WaterSense specification to be consistent with the standard, EPA has determined that performance testing using cased or uncased media is acceptable under this specification. This allowance is included by reference to the standard.

Section 5.0 Supplementary Requirements for Flush Volume Adjustability (Version 1.1)

Section Removal

In Version 1.1 of the specification, *Section 5.0 Supplementary Requirements for Flush Volume Adjustability* included testing protocols intended to limit the flush volume adjustability of certified tank-type toilets. These testing protocols included the fill valve integrity test protocol (Appendix B of Version 1.1 of the specification) and the tank trim adjustability testing protocol (Appendix C of Version 1.1 of the specification). These testing protocols were adopted by the ASME A112.19.2/CSA B45.1 standard, which is now incorporated by reference in Section 2.0 of the specification. Therefore, WaterSense removed these requirements from the specification to minimize redundancy. This change does not affect the specification's original requirements or intent.

Section 5.0 Product Marking

Tank Marking Requirements

Toilet tank marking requirements identified in ASME A112.19.5 *Flush valves and spuds for water closets, urinals, and tanks* (referenced in Version 1.1 of the specification) require manufacturers to permanently mark or label the tank with information pertaining to the appropriate flush valve replacement parts. These requirements have subsequently been incorporated into ASME A112.19.2/CSA B45.1. Therefore, WaterSense updated the specification to reference compliance with the toilet fixture marking requirements identified in the ASME A112.19.2/CSA B45.1 standard.

Bowl Marking

Version 1.1 of the specification allowed toilet bowls to be marked in a manner that indicated compatibility with flush volumes below 1.6 gallons per flush (gpf). This requirement was intended to alleviate confusion because many manufacturers were marking their toilet bowls with a 1.6 gpf flush volume despite compatibility and certification with tanks that flush at lower volumes (e.g., 1.28 gpf). The revisions to ASME A112.19.2/CSA B45.1 now include provisions clarifying the marking requirements for bowls that are compatible with lower (or varying) flush volumes. Specifically, the standard allows toilet bowls to be marked using the words "or less," a dual consumption marking, or a consumption range.

WaterSense is incorporating by reference the bowl marking requirements from the ASME/CSA standard, which will provide clarity on the appropriate ways to mark bowls that are compatible with a range of flush volumes. However, WaterSense is taking exception to the allowance for the use of the words "or less." Placing a marking on the bowl that identifies a maximum flush volume along with the words "or less" could imply that the bowl is compatible with tanks of any flush volume, potentially below the minimum the flush volumes with which the bowl was certified to perform.

Section 8.0 Definitions

Referenced Standards

WaterSense has removed the reference to ASME A112.19.5, as the marking requirements have been incorporated into ASME A112.19.2/CSA B45.1.

Definitions

WaterSense has removed the definition of an electrohydraulic toilet because it is incorporated by reference in ASME A112.19.2/CSA B45.1.

WaterSense has revised the definition of a pressure-assist toilet to use language consistent with definitions included in ASME A112.19.2/CSA B45.1.

WaterSense has revised the definition of rated flush volume to be consistent with the definition included in other WaterSense product specifications. The new definition clarifies that the rated flush volume is specified by the manufacturer and verified through testing to ensure compliance with the specification.

Appendix A: Fixture Performance Testing Protocol (Version 1.1)

Section Removal

As mentioned previously, a majority of the fixture performance testing protocol, originally provided in Appendix A of Version 1.1 of the specification, is now incorporated by reference in the ASME A112.19.2/CSA B45.1 standard. One exception is the flush volume measurement limits that dictate whether the toilet passes, fails, or should be readjusted for testing. To reduce redundancy with the standard, WaterSense has subsequently moved these requirements to Section 3.0 and has removed the entirety of Appendix A from the specification. This change does not affect the specification's original requirements or intent.

Appendix B: Fill Valve Integrity Test Protocol (Version 1.1)

Section Removal

As mentioned previously, the fill valve integrity test protocol, originally provided in Appendix B of Version 1.1 of the specification, is now incorporated by reference in the ASME A112.19.2/CSA B45.1 standard. To reduce redundancy with the standard, WaterSense has subsequently removed the entirety of Appendix B from the specification. This change does not affect the specification's original requirements or intent.

Appendix C: Tank Trim Adjustability Testing Protocol (Version 1.1)

Section Removal

As mentioned previously, the tank trim adjustability testing protocol, originally provided in Appendix C of Version 1.1 of the specification, is now incorporated by reference in the ASME A112.19.2/CSA B45.1 standard. To reduce redundancy with the standard, WaterSense has

subsequently removed the entirety of Appendix C from the specification. This change does not affect the specification's original requirements or intent.

Appendix A: Requirements for WaterSense Labeling

Section 3.3 Product Packaging Marking and Labeling

Section 3.3 of Appendix A provides additional product packaging marking and labeling requirements for toilet tanks and bowls that are packaged and sold individually. Version 1.1 prohibited the WaterSense label on toilet bowl packaging that indicated compatibility with flush volumes greater than the rated flush volume identified in this specification. WaterSense developed that requirement to prevent confusion about whether a bowl with an advertised flush volume higher than the maximum allowed by the specification was actually labeled.

The new bowl marking requirements identified in ASME A112.19.2/CSA B45.1, and now incorporated by reference in the specification, should eliminate this confusion as toilet bowls can be marked with a dual consumption marking or a consumption range to indicate compatibility with multiple flush volumes. Therefore, EPA is now requiring the toilet tank and bowl packaging, in all cases, to bear the WaterSense label.

Timeline for Compliance with Version 1.2 of the Specification

Version 1.2 of this specification goes into effect June 2, 2014. EPA is providing manufacturers with a six-month grace period to begin complying with the new requirements. By December 2, 2014 all certification activities must be completed in accordance with Version 1.2 of this specification, in order for tank-type toilets to earn the WaterSense label. The existing licensing agreements between EPA and the licensed certifying body will remain in full force and effect.

Clothes Washer

Crisp, Clean Clothes Without the Waste

Washing laundry is a significant use of water in the average home; accounting for 15% to 40% of the overall water consumption inside the typical household of four persons. The average American family washes almost 400 loads of laundry each year.

Water Factor

Because washers come in various sizes and capacity, the water efficiency of clothes washers is rated using the term "Water Factor" to accurately compare water use. Water Factor (WF) is measured by the quantity of water (gallons) used to wash each cubic foot of laundry.

Older Washers

An old school washer will use approximately 40 to 45 gallons (151.4 L to 170.3 L) of water per load and have a water factor of 10 or higher. A family of four using a standard clothes washer will generate more than 300 loads per year, consuming 12,000 gallons (45.4 m^3) of water annually.

High Efficiency Washers

New, High-Efficiency Washers (HEW) (front loading or top loading machines are available) can use 14 to 25 gallons (53 L to 94.6 L) of water per load and will have a water factor of 8 or less. Replacing an old and inefficient clothes washer can reduce this water use by more than 6,000 gallons per year (22.7 m^3), save energy, clean the clothes better, and reduce fabric wear.

Clothes Washer Water Saving Tips

1. Run full loads only, even if the washer has an adjustable load setting. A full load is the most efficient way to wash clothes.
2. Replace the old inefficient clothes washer with a new high-efficiency model to save water and energy.

More Information About Clothes Washers

Standard Washers

The standard top loading clothes washer, using a vertical-axis drum, has changed little from General Electric's design in 1947. The vertical axis design requires enough water in the drum to suspend the fabric in the soapy water while the agitator churns the clothes to help remove dirt and stains. The large amount of water required to suspend the fabric in the tub limits the ability for this type of washer to efficiently use water. Historically, vertical axis washers consumed 45 gallons per load (170 L), though newer models of the past few years have reduced this to less than 40 gallons per load (151.4 L). Even the best designs manufactured today require more than 9 gallons (34.1 L) of water per cubic foot of capacity (28.31 L).

High-Efficiency Washers

High-efficiency front or top loading washers facilitate greater efficiency because they use less water and energy. These high-tech machines are proven to be more effective in cleaning the clothes with less water, and is gentler on the fabric when compared to old-school vertical axis washers. Additional benefits of lower water use are: a) less laundry detergent is required; and, b) less water needs to be heated resulting in energy conservation. Most high-efficiency washers use only 15 to 30 gallons (56.8 to 113.6 L) of water to wash the same amount of clothes as older washers (29 to 45 gallons per load (109.7 to 170 L). The most efficient washers use less than 5 gallons (18.9 L) per cubic foot of capacity.

Water Efficiency of Washers

The smaller the water factor rating, the more water efficient the clothes washer. A typical residential clothes washer has a capacity of approximately 3 cubic foot, though sizes range from 1.7 cubic feet (48.13 L) to more than 4.2 cubic feet (118.9 L) for the extra large capacity machines. The Water Factor provides a means to directly compare water efficiency of different sized machines.

Efficiency Example

Washer A uses 32 gallons of water per load (wash and rinse cycles) with a 4 cubic foot capacity of laundry; thus, has a Water Factor rating of 8 (32÷4=8).

Washer B uses 30 gallons of water (wash and rinse cycles) with a 2.5 cubic foot capacity; thus, has a Water Factor rating of 12 (30÷2.5=12).

Washer A uses water more efficiently (WF=8) than Washer B (WF=12). While Washer A uses slightly more water per load, it can clean 40% more clothes per load.

Looking for a New Water Efficient Washer?

When buying a new machine, finding the Water Factor rating of a clothes washer is not always easy. Though manufacturers measure Water Factors for each model of washer, manufacturers are not required to display the rating on the machine. Fortunately, the Energy Star Program reports **Water Factors and energy use for nearly every HEW in the market**.

Listing of High Efficiency Clothes Washers

Are you in the market for a new clothes washer? The most recent listings of high-efficiency clothes washers are provided here:

- **CEE Residential Clothes Washers Qualifying Product List**

CLOTHES WASHERS

For Partners

OVERVIEW

SPECIFICATION

BUYING GUIDANCE

PROMOTIONS

The average American family washes about 300 loads of laundry each year. ENERGY STAR can help families cut their related energy and water costs. ENERGY STAR certified clothes washers use about 25% less energy and 33% less water than regular washers. Over the lifetime of the product, models that have earned the ENERGY STAR can save $380 in energy costs.

They have a greater tub capacity which means you can wash fewer loads to clean the same amount of laundry. They are available in front-load and top-load models from brands including Blomberg, Asko, GE, Kenmore, LG, Samsung, Whirlpool, and many more. ENERGY STAR top-load models utilize new technologies that do not require the tub to fill with water. They clean using sophisticated wash systems to flip or spin clothes through a stream of water. Many have sensors to monitor incoming water levels and temperature. They also rinse clothes with repeated high-pressure spraying instead of soaking them in a full tub of water.
Consider the following:

- **Use less energy.** On average, a new ENERGY STAR certified clothes washer uses 316 kWh of electricity and can save you about $35 a year on your utility bills compared to a standard model.
- **Use less water.** A full-sized ENERGY STAR certified clothes washer uses 14 gallons of water per load, compared to the 20 gallons used by a standard machine. That's a savings of more than 2,000 gallons of water, per year!!
- **Is your washer over 10 years old?** It's estimated that there are 74 million top-loading washers and 24 million front-loading washers - 26 million of which are at least 10 years old, still in use across the country. Washers that are approximately 10 years old are significantly less efficient than newer models. Together, these inefficient washers cost consumers about $4.7 billion each year in energy and water. If you have a standard clothes washer that is approximately 10 years old, it's costing you, on average $185 a year.

If every clothes washer purchased in the U.S. was ENERGY STAR certified, we could save more than $3.3 billion each year and prevent more than 19 billion pounds of annual greenhouse gas emissions, equal to the emissions from more than 1.8 million vehicles.

5. Technical Advisory Council Report for Wastewater Flows from Single Family Dwellings.

Executive Summary
Wastewater Flows from Single Family Dwellings

Study done for the Michigan Technical Advisory Council for Onsite Wastewater Treatment
Danielle N. McEachin and Ted L. Loudon
Student Intern and Professor, respectively,
Agricultural Engineering Department
Michigan State University

The purpose of this study was to collect, organize and present what is known about the amount of wastewater that can be expected to flow from dwellings. Th goal is to provide designers and regulators with an actual flow based data set from which to develop design flow numbers for sizing systems. The data in this document comes from a variety of sources. Most were found on the Internet, some were found in the library, and others were provided from file data collected by entities in Michigan. The study was restricted to data collected during the years 1980-2000, so that the values determined would be representative of life styles of the present generation. In fact, only two numbers in the data tables are from before 1987.

A group of studies providing metered home water use rates presented in units of gpd per capita from around the country were reviewed and summarized. When averages were weighted based on the number of homes per study, the overall weighted average per capita daily water use was just under 51 gpd (Table 1). The value of this data is limited by the fact that much of the data was total use, including outdoor water use, and had to have a correction factor applied. Numerous sources containing recommended per capita design flows were reviewed. Most recommendations are in the 50-70 gpd/c range (Table 4).

Perhaps the most valuable data is data gathered in Michigan. A study of metered data from 700 homes in southern Michigan showed an average daily use per home of 214.3 gallons. The three bedroom home average was 221.3 gpd (74 gpd/br) and the four bedroom average was 285.5 gpd (71 gpd/br). A study of measured flows from 66 homes in Jackson County showed flows of 56 gpd per bedroom.

Average per person flows, averaged over large numbers of people, appear to be in the 50-55 gpd/c range. Average flows expressed per bedroom, for 3-4 bedroom homes appear to be in the 70-75 gpd/br range. While bedrooms do not generate flow, people do, it is common to design on the basis of number of bedrooms since occupancy varies. For large clusters of homes, designing on the basis of 75 gpd/br would appear to be supported by the data available. For an individual home design, a significant safety or peaking factor must be applied. Many of the references consulted suggest a factor of 2 or even 2.5. Use of a high design flow for individual homes helps to compensate for the state of the art in site evaluation and the occasional high water use occupancy.

The Technical Advisory Council will produce a companion guidance document providing recommendations for applying this data in design recommendations.

Wastewater Flows from Single Family Dwellings

Study done for the Michigan Technical Advisory Council for Onsite Wastewater Treatment

Danielle N. McEachin and Ted L. Loudon
Student Intern and Professor, respectively,
Agricultural Engineering Department
Michigan State University

Purpose: Rational design of wastewater treatment and dispersal systems is based on the flow that the system must be able to handle. This is usually expressed on a daily flow basis and typically includes a factor of safety which is large for individual home systems and may be reduced as systems are clustered together. The purpose of this study was to collect, organize and present what is known about the amount of wastewater that can be expected to flow from dwellings. The goal is to provide designers and regulators with an actual flow based data set from which to develop design flow numbers for sizing systems.

The data in this document comes from a variety of sources. Most were found on the Internet, some were found in the library, and others were provided from file data collected by entities in Michigan. Every effort was made to ensure that the data reflect indoor water use, which eliminates most consumptive uses and represents the flow that would be expected in the wastewater system. Because consumptive uses are hard to eliminate completely, particularly in arid climates, we restricted our data to the more humid states. One exception is that a study from Denver, CO is included in which a significant effort was made to eliminate outdoor consumptive uses in the design of the study. The numbers in the Colorado study are higher than those from more humid states but we cannot determine exactly what the reason for this might be. Wherever total water use numbers were encountered they were multiplied by a factor of 0.70 to give indoor water use only. These values are indicated by a *. This factor is based on the findings of multiple studies which measured both indoor and outdoor usage. We restricted our selection of data to include only data collected during the years 1980-2000, so that the values determined would be representative of life styles of the present generation. In fact, only two numbers in the data tables are from before 1987, and these are from a study deemed to be sufficiently reliable that we did not wish to exclude it.

The data are divided into four tables. Table 1 contains data from literature and internal sources that were obtained through actual measurement. This means that the numbers were derived from meter readings at occupied residences. These numbers are from studies where multiple homes were metered and the indoor water use was determined. Only some of these studies reported indoor water use only. For those where the reported values were total use, the 0.70 factor was used to obtain indoor water use numbers. See footnotes following the tabulated data for the basis of this factor. The study done by the American

Water Works Association Research Foundation metered 1188 homes to obtain their data. The Denver Board of Water Commissioners metered 5649 homes in the city and county of Denver.

The U.S. Department of Housing and Urban Development has conducted many studies on residential water use. In some of their work, they designed studies to obtain as diverse a group of homes as possible by gathering data on each household through issuing a questionnaire to each resident. Their study entitled "Water Saved by Low-flow Fixtures" included water meter data from over 200 homes. They also conducted a study of flow from apartment buildings in which they collected data from 23 buildings. The apartments were noted to be especially leaky and they found unusually high per capita water use. The U.S. Geological Survey published a table with water use values for every state. We selected data from the more humid states and applied the 0.70 factor to obtain indoor water use values. Data were collected from homes where the water supply was from both self-supplied (SS) and public-supplied (PS) sources.

Table 2 contains data that was found through actual measurement but is presented as gallons per day per home. The Michigan study done by Equinox Inc. for use in the design of the Mill Valley Condominium Subdivision metered over 700 homes in Livingston and Oakland counties and determined average water use per dwelling. The first 7 entries in Table 2 represent flows averaged over multiple single family dwellings and would be representative of flows to be expected from a cluster of homes. The average flow equals 159 GPD/home over 640 homes. The Michigan Department of Environmental Quality study involved determination of metered flows from over 500 homes in Oakland County and Highland Township. Both of these Michigan studies are believed to be highly reliable but resulted in per home flows that were higher.

Table 3 contains data found through actual measurement but the values were presented in the original studies in units of gallons per day per bedroom. This data is from a study done by the Michigan Department of Environmental Quality. In this study, 66 homes were metered in Jackson County and the size of home determined so that the data could be presented in terms of a per bedroom water use average.

Table 4 contains data from publications which give representative numbers that are recommended for design of wastewater systems. These are not well referenced so it is unclear whether they originally came from actual use studies or are estimates, possibly including a safety factor, that are simply repeated from another publication. These sources were mostly found on the Internet.

After the tables are a set of statements and observations gleaned from literature. The effect of income level and household size on water use is analyzed. Our reasons for using the 0.70 factor are given, a comparison of self-supplied and public-supplied water use is given. Typical times of peak water use are analyzed as are the effects of metering and water pressure.

Conclusions that can be drawn:

From Table 1, the per capita metered indoor water use data from nationwide studies show an average value of 69 gallons per person per day. The per capita data obtained by applying the 0.70 factor to total water use data found in humid climates shows an average value of 55.2 gallons per day, with a self-supplied average of 50.5, a public-supplied average of 57.7 and a range of 35-86.8. The weighted average per capita water use data for all homes in Table 1 show an overall average use of 50.7 gallons per day, with a self-supplied use of 51.1 and a public-supplied use of 50.47.

The per home metered indoor data in Table 2 shows an average of 214.3, with a 3 bedroom average of 221.3, a 4 bedroom average of 285.5 and a range of 140-327. The first 7 entries in Table 2 represents measured flow data from 640 Michigan homes and shows an average of 159 GPD/home.

The nationwide data sets show somewhat higher per capita water use. Humid region data suggest that average per capita indoor water use averages between 50 and 70 gpd. Total water use per home averages between 160 and 285 GPD with the larger figure for larger homes.

This should be considered a work in progress. We would like to include additional data. If the reader has or is aware of additional data that could be included, we would like to receive it. This summary will be modified if additional data are received or otherwise located.

Residential Water Consumption Data, From a Variety of Sources Report by: Danielle McEachin

Table 1. Sources whose data was found by actual measurement, measured in GPD/Person

Sponsor	Source	Study	Area of Study	Time Period	Indoor use or Total use?	Type of Dwelling	Per capita daily water use
AWWA Research Foundation	http://www.awwarf.com/exsums/90781.htm	Residential End Uses of Water [Project#241]	12 study sites, across the U.S.	Copyright1999	Indoor	1,188 Single-family homes	69.3, Including Leakage
Denver Board of Water Commissioners	Litke and Kauffman, "Analysis of Residential Use of Water in the Denver Metropolitan Area, CO, 1980-87		16 groups of homes in the city and county of Denver	Data From 1980-87	Indoor	5,649 Single-family homes	64-119 Mean = 85.6
Rhode Island Governor's Office of Housing, Energy, and Intergovernmental Relations	M. A. Horn, P.A. Craft & Lisa Bratton, "Estimation of Water Withdrawal and Distribution, Water Use, and Wastewater Collection and Return Flow in Cumberland, Rhode Island, 1988		Cumberland, Rhode Island	Data From 1988	Indoor and Total	Single-family homes	70 SS (Total) 77 PS (Indoor) & 90 PS (Total)
U.S. Department of Housing and Urban Development, Office	Brown and Caldwell, "Residential Water Conservation Projects, Summary Report", 1984	Water Saved by Low-flow Fixtures	Nationwide	Data from 1983	Indoor	200 Single-family homes	66.2

of Policy Development and Research		Retrofit of Apartment Buildings	Washington, D. C.	Data From 1981	Indoor	23 Apartment buildings	100** Including Leakage

Table 1. (cont.)

Sponsor	Source	Study	Area of Study	Time Period	Indoor use or Total use?	Type of Dwelling	Per capita daily water use
United States Geological Survey	http://water.usgs.gov//watuse/tables/dotab.st.html	Table12. Domestic Freshwater Use by State (States chosen with humidity similar to that of Michigan)	Alabama	Data From 1990	Indoor	Single-family homes	52.5* SS 70* PS
			Arkansas	Data From 1990	Indoor	Single-family homes	61.6* SS 74.2* PS
			Connecticut	Data From 1990	Indoor	Single-family homes	52.5* SS 49* PS
			Delaware	Data From 1990	Indoor	Single-family homes	55.3* SS 54.6* PS
			Georgia	Data From 1990	Indoor	Single-family homes	52.5* SS 80.5* PS
			Illinois	Data From 1990	Indoor	Single-family homes	58.8* SS 63* PS
			Indiana	Data From 1990	Indoor	Single-family homes	53.2* SS 53.2* PS
			Kentucky	Data From 1990	Indoor	Single-family homes	35* SS 49* PS
			Louisiana	Data From 1990	Indoor	Single-family homes	58.1* SS 86.8* PS
			Maine	Data From 1990	Indoor	Single-family homes	63* SS 40.6* PS
			Maryland	Data From 1990	Indoor	Single-family homes	58.1* SS 73.5* PS
			Massachusetts	Data From 1990	Indoor	Single-family homes	50.4* SS 46.2* PS
			Michigan	Data From 1990	Indoor	Single-family homes	51.1* SS 53.9* PS
			Mississippi	Data From 1990	Indoor	Single-family homes	35* SS 86.1* PS

Table 1. (cont.)

Sponsor	Source	Study	Area of Study	Time Period	Indoor use or Total use?	Type of Dwelling	Per capita daily water use
United States Geological Survey	http://water.usgs.gov//watuse/tables/dotab.st.html	Table12. Domestic Freshwater Use by State (States chosen with humidity similar to that of Michigan) (cont.)	Missouri	Data From 1990	Indoor	Single-family homes	42* SS 59.5* PS
			New Hampshire	Data From 1990	Indoor	Single-family homes	45.5* SS 49.7* PS
			New Jersey	Data From 1990	Indoor	Single-family homes	52.5* SS 52.5* PS
			New York	Data From 1990	Indoor	Single-family homes	40.6* SS 83.3* PS
			North Carolina	Data From 1990	Indoor	Single-family homes	38.5* SS 39.9* PS

			Ohio	Data From 1990	Indoor	Single-family homes	52.5* SS 37.5* PS
			Pennsylvania	Data From 1990	Indoor	Single-family homes	36.4* SS 43.4* PS
			Rhode Island	Data From 1990	Indoor	Single-family homes	49* SS 46.9* PS
			South Carolina	Data From 1990	Indoor	Single-family homes	52.5* SS 53.2* PS
			Tennessee	Data From 1990	Indoor	Single-family homes	45.5* SS 59.5* PS
			Vermont	Data From 1990	Indoor	Single-family homes	50.4* SS 56* PS
			Virginia	Data From 1990	Indoor	Single-family homes	52.5* SS 52.5* PS
			West Virginia	Data From 1990	Indoor	Single-family homes	56* SS 51.8* PS
			Wisconsin	Data From 1990	Indoor	Single-family homes	42.7* SS 36.4* PS

Table 1. (cont.)

Sponsor	Source	Study	Area of Study	Time Period	Indoor use or Total use?	Type of Dwelling	Per capita daily water use
United States Geological Survey	http://oh.water.usgs.gov/water_use/95huc.html	Estimated Water Use for Ohio, 1995, by Hydrologic Cataloging Unit	Ohio	Data From 1995	Indoor	Single-family homes	70 SS* 50 PS*
Michigan Department of Public Health		Oakland County Water Use/Population Study	Oakland County, MI	Data From 1991	Total	151 2 bedroom homes	56.7*
						445 3 bedroom homes	49*
						186 4 bedroom homes	51.8*
						30 5 bedroom homes	57.4*

SS = Self-supplied
PS = Public-supplied
*Converted to Indoor Use From Total Use by using the formula Indoor Use = (0.70) Total Use
** This study stated these apartments to have an especially large amount of leakage and therefore the numbers from these apartments were not used in any averages

Average per capita indoor water use = 50.76
SS average per capita indoor water use = 51.1
PS average per capita indoor water use = 50.47
Range of per capita water use = 35-100

Table 2. Sources whose data was found by actual measurement, measured in GPD/Home

Sponsor	Study	Area of Study	Time Period	Indoor use or Total use?	Type of Dwelling	GPD/ Home
Equinox, Inc., Stephens Consulting, Inc.	Daniel C. Schrauben and David R. Beschke, "Basis of Design, Flow Adjustment, Wastewater System, Mill Valley Condominium Subdivision", June 17, 1999.	Deer Creek	Data From 1990	Indoor	3 single-family homes	148
		Greenock Hills No. 3	Data From 1990	Indoor	20 single-family homes	158
		Lake Tyrone	Data From 1990	Indoor	182 single-family homes	165
		Portage Bay	Data From 1990	Indoor	20 single family homes	140
		Runyan Lake	Data From 1990	Indoor	274 single-family homes	164
		Sandy Creek	Data From 1990	Indoor	5 single-family homes	154
		Tanglewood	??	Indoor	136 single-family	145

					homes	
		City of Novi	Data From 1990-1992	Indoor	4 bedroom home	327
		City of Novi	Data From 1990-1992	Indoor	3 bedroom home	234
		Eagle Ravine	Data From 1990	Indoor	8 Single-family homes	270
		Milford Bluffs	Data From 1990	Indoor	3 bedroom home	222
		Milford Bluffs	Data From 1990	Indoor	4 bedroom home	255
		Settler's Pointe	Data From 1990	Indoor	3 bedroom home	213

Table 2. (cont.)

Sponsor	Study	Area of Study	Time Period	Indoor use or Total use?	Type of Dwelling	GPD/ Home
Equinox, Inc., Stephens Consulting, Inc.	Daniel C. Schrauben and David R. Beschke, "Basis of Design, Flow Adjustment, Wastewater System, Mill Valley Condominium Subdivision", June 17, 1999. (cont.)	Settler's Pointe	Data From 1990	Indoor	4 bedroom home	281
		Village of Milford	??	Indoor	4 bedroom home	209
		Village of Milford	??	Indoor	3 bedroom home	206
Michigan Department of Public Health	Oakland County Water Use/Population Study	Oakland County, MI	Data From 1991	Total	3 Bedroom home	197
					4 Bedroom home	257
	Highland Township, Four Bedroom and Three Bedroom Water Usage Comparison	Highland Township	Data From 1993	Total	3 Bedroom home	256
					4 Bedroom home	284

Average per home indoor water use (all homes) = 214.3
Average indoor water use (3 bedroom homes) = 221.3
Average indoor water use (4 bedroom homes) = 285.5
Range of indoor water use (all homes) = 140-327

Table 3. Sources whose data was found by actual measurement, measured in GPD/BR

Sponsor	Study	Area of Study	Time Period	Indoor use or Total use?	Type of Dwelling	GPD/ Bedroom
Michigan Department of Public Health	Engineering Company Review of One Subdivision, Jackson County	Jackson County	Data From 1991	Total	66 single-family homes (3 & 4 bedrooms)	56

Table 4. Sources using published numbers (recommended for design use)

Sponsor	Source	Study	Area of Study	Time Period	Indoor use or Total use?	Type of Dwelling	Per capita daily water use
Auburn University	http://hermes.ecn.purdue.edu/cgi/convertwq?7696	Conserving Water, Developing Water-Conserving Habits: A Checklist	Alabama	Data From 1995	Indoor	Single-family homes	50-70
Domestic Wastewater Systems & Pump Talk, R.L. Peeks Pump Sales	http://freehosting1.at.webjump.com/6eba64886/pu/pumpman-webjump/plan.htm	Planning Your Water System	N/A	Last Modified May 2000	Indoor	Single-family homes	75
Individual Sewage Treatment System (ISTS), Scott County	http://www.co.scott.mn.us/EH/ISTS/septic.htm	Water Usage and Your On-Site Sewage Treatment System	Minnesota	Data From 1990	Indoor	Single-family homes	52.5*-70*
Kennewick Public Works Department	http://www.ci.kennewick.wa.us/pw/watercon.htm	32 Tips on Water Conservation	Washington	Last Modified June 2000	Indoor	Single-family homes	63.75
Michigan State	http://hermes.ecn.purdue.edu/cgi/convertwq?5373	How to Conserve	Michigan	Data from	Indoor	Single-family	50-70

University, Extension		Water in Your Home and Yard		1987		homes	
Missouri Department of Natural Resources, Energy Center	http://www.dnr.state.mo.us/de/residential/waterusage.htm	Residential Energy Efficiency, Water Usage	Missouri	Last Modified Mar. 2000	Indoor	Single-family homes	50
North Carolina Cooperative Extension Services	http://www.bae.ncsu.edu/bae/programs/extension/publicat/wqwm/he250.html	Focus on Residential Water Conservation	North Carolina	Last Modified Mar. 1996	Indoor	Single-family homes	52.5*
Polk County, Department of Water Conservation	http://www.co.polk.ia.us/departments/conserv/kids.asp.html	Water Conservation for Kids	Iowa	Last Modified June 2000	Indoor	Single-family homes	50

Sponsor	Source	Study	Area of Study	Time Period	Indoor use or Total use?	Type of Dwelling	Per capita daily water use
Prairie Water News, Vol. 12, no. 1	http://www.quantumlynx.com/water/back/vol12no1/v21_st2.html	Bill Anderson, "Water Use Trends on the Prairies"	Saskatchewan	Spring, 1992	Indoor	Single-family homes	50 SS
Ron Crites and George Tchobanoglous, "Small and Decentralized Wastewater Management Systems, 1999.			N/A	Copyright, 1999	Indoor	High rise	55
						Low rise	55
						Hotel	40
						Newer home	70
						Older home	50
						Summer cottage	40
						Motel w/kitchen	100
						Motel w/o kitchen	95
						Trailer park	40
United States Environmental Protection Agency (EPA), Office of Water	http://www.epa.gov/OGWDW/wot/howmuch.html	How Much Drinking Water Do We Use in Our Homes	N/A	Last Modified June 2000	Indoor	Single-family homes	54.5
United States Geological Survey	http://water.usgs.gov/outreach/poster3/grade_school/Page7.html	Water Resources Outreach Program	N/A	Last Modified Mar. 2000	Indoor	Single-family homes	79
University of Arkansas	http://hermes.ecn.purdue.edu/cgi/convertwq?7541	Home Water Use Management	Arkansas	Data From 1992	Indoor	Single-family homes	63.75
University of Georgia	http://hermes.ecn.purdue.edu/cgi/convertwq?6229	Conserving Water at Home	Georgia	Data From 1991	Indoor	Single-family homes	50-75
University of Maine	http://hermes.ecn.purdue.edu/cgi/convertwq?6453	Conserving Water at Home	Maine	Data From 1991	Indoor	Single-family homes	45-50

Sponsor	Source	Study	Area of Study	Time Period	Indoor use or Total use?	Type of Dwelling	Per capita daily water use
University of Maryland	http://hermes.ecn.purdue.edu/cgi/covertwq?5321	Margaret T. Ordonez, "Water Conservation	Maryland	??	Indoor	Single-family homes	50-75

		In the Home."					
University of Minnesota	http://www.extension.umn.edu/distribution/youthdevelopment/components/0328-05.html	Water Use and Conservation	Minnesota	Last Modified June 2000	Indoor	Single-family homes	50
University of Rhode Island	http://hermes.ecn.purdue.edu/cgi/convertwq?6425	Alyson McCann and Thomas P. Husband, "Water Conservation In and Around the Home.", 1999.	Rhode Island	Data From 1991	Indoor	Single-family homes	50-75

SS = Self-supplied
PS = Public-supplied
*Converted to indoor use from total use by using the formula Indoor Use = (0.70) Total Use

Range of per capita water use for homes = 40-79

Interesting Observations on the Effects of Some Factors on Water Use

- Water-conserving toilets were shown to leak more often than non-conserving ones in the "Water Saved by Low-flow Fixtures" study done by the U.S. Department of Housing and Urban Development.
- Effects of income level and household size on water use:
  - To determine the effects of income on residential water use, the study "Water Saved by Low-flow Fixtures" by the U.S Department of Housing and Urban Development compared the average interior water use in gallons per capita-day for each household with the average income range for that household. The scatter plot of this data showed a wide variation of per capita water use within each income range.
  - The average interior water use values for each income bracket were also compared, and showed little or no correlation between income and water use.
  - In this same study, the average interior water use in gpcd was compared with household size. A wide variation of water usage within each household size was observed. However, the comparison of average interior water use for each group of household sizes did show a decreasing trend in per capita use as the number of people in the house increased.
  - If outside use were also included in this study, a correlation between income and water use would most likely be observed, due to bigger yard size and pools.
  - In the study, "Analysis of Residential Use of Water in the Denver Metropolitan Area, Co", it was found that Indoor water use correlated best with persons per household and that correlation with assessed value was very low.
  - The Oakland County Water Use/Population Study also showed little or no correlation between assessed value and water use.
  - It is interesting to note, however, that homes with low incomes may not have washing machines or dishwashers, while homes with higher incomes usually do. This could have a great effect on water use.
- Indoor water use as a function of total water use:
  - Indoor water use is said to be about seventy-five percent of total water use in the document, "Focus on Residential Water Conservation" by the North Carolina Cooperative Extension Service.
  - The book "Small and Decentralized Wastewater Management Systems" states that, "If a community has a water system but not a wastewater collection system, the average wastewater flow-rate can be estimated by multiplying the water use by a factor of sixty-eighty percent, depending on the landscaping." This is approximately equivalent to saying that base water use is sixty-eighty percent of total water use.
  - The Oakland County Water Use/Population Study shows a difference between winter and summer water use of sixty-six percent.
  - Based on these observations some of the total water use data in the above table was multiplied by a factor of 0.70 to get the indoor water use.
  - The study "Analysis of Residential use of Water in the Denver Metropolitan Area, Co" states that, "Water used to grow lawns in Denver is forty-two percent of water consumption." This is because Colorado is a very dry state.

- Times of peak water use:
  - In the study, "Analysis of Residential Use of Water in the Denver Metropolitan Area, Co", it is stated that, "more water is used in the summer, on Sundays, and from 7 a.m.– 9 a.m."
  - On the EPA's website "How Much Drinking Water Do We Use In Our Homes?", it states that
    - The lowest rate of use is from 11:30 p.m. to 5:00 a.m.
    - There is a sharp rise in use from 5:00 a.m. to noon, with a peak hourly use from 7:00 a.m. to 8:00 a.m.
    - There is a moderate use from noon to 5:00 p.m., with a lull around 3:00 p.m.
    - There is an increase in use in the evening from 5:00 to 11:00 p.m., with the second minor peak from 6:00 to 8:00 p.m.
- Metered versus flat rate customers:
  - The study, "Water Saved by Metering", done by the U.S. Department of Housing and Urban Development compares metered customers' water use with that of flat rate customers.
  - Denver is unique because it has both metered and flat rate customers. Since 1957, all new homes have been required to be metered. In spite of this, most customers are flat rate because they pre-existed this policy. Because of this, nearly identical homes in the same area can have different billing systems.
  - To study the effect of metering, one group of twenty-five metered homes and two groups of flat-rate homes (forty-two homes total) were identified, and there water use data collected for a period of three-years.
  - The test groups were selected so those factors such as fire hydrants and downstream water uses were eliminated.
  - Over the three-year period of data collection, water use in metered homes averaged about 453 gallons per day (total, 42% is yard watering), and water use in flat-rate homes averaged about 566 gpd. Thus, metered homes used twenty-percent less water than flat-rate homes.
  - The basic effect of metering is to reduce the amount of water used for irrigation. Therefore, water use would be reduced more in a dry area such as Denver than a more humid area.
- Effect of water pressure on water use:
  - Reducing water pressure can be one means of reducing water use. A decrease in water pressure causes a decrease in water flow related to the square root of pressure drop.

- Many water use appliances regulate the volume of water they use, eliminating the effect of water pressure. Water pressure does, however, have an effect on water leakage and outdoor water use.
- The U. S. Department of Housing and Urban Development did a study on water pressure entitled, "Effect of Water Pressure on Water Use", in which they studied different pressure zones in Denver, Los Angeles, and Atlanta. They found a difference of about two-three percent in the water use of homes with high compared to low pressure (difference of about 35 psi).

- Equations Related to Water Use
  - The book, "Small and Decentralized Wastewater Management Systems", states that the equation for flow from a residence can be given as: Flow, gal/home*day = 40 gal/home*day + 35 gal/person*day x (number of persons/home).
  - The document, "Water Use", given to me by Larry Stephens describes three types of residences, with separate equations for estimating water use.
    - In a Type I residence the total floor area of the residence divided by the number of bedrooms is more than 800 square feet, or more than two of the following water-use appliances are installed: automatic washer, dishwasher. In a Type I residence the estimated water use is equal to 150 gpd/bedroom. This assumes an occupancy of two people per bedroom, each using 75 gpd.
    - In a Type II residence the total floor area of the residence divided by the number of bedrooms is more than 500 square feet and there are no more than two water-use appliances. Water use in a Type II residence is obtained by multiplying 75 times a factor equal to the number of bedrooms plus one.
    - In a Type III residence the total floor area of the residence divided by the number of bedrooms is more than 500 square feet and there are no more than two water-use appliances. Water use in a Type III residence is obtained from the formula: 66+38(number of bedrooms +1).

References

Anderson, Bill. 2000. Water Use Trends on the Prairies. Prairie Water News Vol. 12, No. 1 (1992) August 2000. <http://www.quantumlynx.com/water/back/vol2no1/v21_st2.html>.

AWWA Research Foundation Webpage. 2000. "Residential End Uses of Water [Project#241]" June 2000 <http://www.awwarf.com/exsums/90781.htm>.

Brown and Caldwell. 1984. Residential Water Conservation Projects, Summary Report. USDHUD.

University of Georgia. August 2000. Conserving Water At Home. <http://hermes.ecn.purdue.edu/cgi/convertwq?6229>.

University of Maine. August 2000. Conserving Water At Home. <http://hermes.ecn.purdue.edu/cgi/convertwq?6453>.

Auburn University. August 2000. Conserving Water, Developing Water-Conserving Habits: A Checklist. <http://hermes.ecn.purdue.edu/cgi/convertwq?7696>.

Crites, Ron and Tchobanoglous, George, "Small and Decentralized Wastewater Management Systems", 1999.

R. L. Peeks Pump Sales. July 2000. Domestic Wastewater Systems and Pump Talk. <http://freehosting1.at.we.bjump.com/6eba64886/pu/pumpman webjump/plan.htm>.

United States Geological Survey. August 2000. Estimated Use of Water in the U. S. in 1990. <http://water.usgs.gov//watuse/tables/dotab.st.html>.

United States Geological Survey. August 2000. Estimated Water Use for Ohio, 1995. <http://oh.water.usgs.gov/water_use/95huc.html>.

North Carolina Cooperative Extension Service. August 2000. Focus on Residential Water Conservation. <http://www.bae.ncsu.edu/bae/programs/extension/publicat/wqwm/he250.html.

University of Arkansas. August 2000. Home Water Use Management. <http://hermes.ecn.purdue.edu/cgi/convertwq?7541>.

Horn, M.A., Craft, P.A., Bratton, Lisa. 1988. Estimation of Water Withdrawal and Distribution, Water Use, and Wastewater Collection and Return Flow in Cumberland, Rhode Island. Rhode Island's Governor's Office of Housing, Energy and Intergovernmental Relations.

United States Environmental Protection Agency (EPA), Office of Water. August 2000. How Much Drinking Water Do We Use in Our Homes. <http://www.epa.gov/OGWDW/wot/howmuch.html>.

Michigan State University Extension. July 2000. How to Conserve Water in Your Home and Yard. <http://hermes.en.purdue.edu/cgi/convertwq?5373>.

Litke and Kauffman. 1988. Analysis of Residential use of Water in the Denver Metropolitan Area. Denver Board of Water Commissioners.

Michigan Department of Environmental Quality. 1999. Oakland County Water Use/Population Study, 1991, Highland Township Water Use Data, 1993, and Jackson County Sanitary Flow Comparison.

Missouri Department of Natural Resources Energy Center. August 2000. Residential Energy Efficiency. <http://www.dnr.state.mo.us/de/residential/waterusage.htm>.

Schrauben, Daniel and David Beschke. 1999. Basis of Design Flow Adjustment, Wastewater System Mill Valley Condominium Subdivision. Equinox Inc. June 1999.

Polk County, Department of Water Conservation. August 2000. Water Conservation For Kids.
<http://www.co.polk.ia.us/departments/conserv/kids.asp.html>

U of Rhode Island. August 2000. Water Conservation In and Around the Home.
<http://hermes.ecn.purdue.edu/cgi/convertwq?6425>.

University of Maryland. August 2000. Water Conservation In the Home.
<http://hermes.ecn.purdue.edu/cgi/convertwq?5321>.
Unites States Geological Survey. August, 2000. Water Resources Outreach Program Page.
<http://water.usgs.gov/outreach/poster3/grade_school/Page7.html>.

_____Water Usage and Your Onsite Sewage Treatment System. Individual Sewage Treatment System (ISTS), Scott County, MN. July 2000.
<http://www.co.scott.mn.us/EH/ISTS/septic.htm>.

University of Minnesota. August 2000. Water Use and Conservation.
<http://www.extension.umn.edu/distribution/youthdevelopment/components/0328-05.html>.

Kennewick Public Works Department. July, 2000. 32 Tips on Water Conservation <http://www.ci.kennewick.wa.us/pw/watercom.htm>.

6. Existing information.

HARNETT COUNTY TAX ID #
130529 0019 02 & others

Matthew S. Willis Register of Deeds
Harnett County, NC
Electronically Recorded
02/22/2023 02:59:06 PM NC Rev Stamp: $13,439.00
Book: 4183 Page: 652 - 657 (6) Fee: $26.00
Instrument Number: 2023002656

02-22-2023 BY: TC

NORTH CAROLINA SPECIAL WARRANTY DEED

Excise Tax: $13,439.00 NO TITLE SEARCH NOR TAX ADVICE GIVEN

Parcel Identifier No. **See Exhibit C** Verified by _____ County on the ____ day of_____, 20____
By:_____

Mail/Box to: Grantee

This instrument was prepared by: Currie Tee Howell, Attorney; Adams, Howell, Sizemore & Adams, P.A.

Brief description for the Index: Lots 1 through 89, inclusive, Wellers Knoll Subdivision

THIS DEED made this 22 day of February, 2023, by and between

GRANTOR	GRANTEE
Weller Developers, LLC, a North Carolina limited liability company	BC Wellers Knoll, LLC, a North Carolina limited liability company
10305 Penny Road Raleigh, NC 27606	336 James Record Road Huntsville, AL 35824

Enter in appropriate block for each Grantor and Grantee: name, mailing address, and, if appropriate, character of entity, e.g. corporation or partnership.

The designation Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine or neuter as required by context.

WITNESSETH, that the Grantor, for a valuable consideration paid by the Grantee, the receipt of which is hereby acknowledged, has and by these presents does grant, bargain, sell and convey unto the Grantee in fee simple, all that certain lot or parcel of land situated in Upper Little River Township, Harnett County, North Carolina and more particularly described as follows:

See attached Exhibit A

The property hereinabove described was acquired by Grantor by instrument recorded in Book 4090, Page 433.

All or a portion of the property herein conveyed _____ includes or X does not include the primary residence of the Grantor.

A map showing the above described property is recorded in Plat Book 2023, Pages 59-62.

TO HAVE AND TO HOLD the aforesaid lot or parcel of land and all privileges and appurtenances thereto belonging to the Grantee in fee simple.

And the Grantor covenants with the Grantee, that Grantor has done nothing to impair such title as Grantor received, and Grantor will warrant and defend the title against the lawful claims of all persons claiming by, under or through Grantor, other than the following exceptions:

See attached Exhibit B for Permitted Exceptions

IN WITNESS WHEREOF, the Grantor has duly executed the foregoing as of the day and year first above written.

GRANTOR:

Weller Developers, LLC, a North Carolina limited liability company

By: H. L. Montague, III (SEAL)
Harvey L. Montague, III, Manager

State of NC - County or City of Wake

I, the undersigned Notary Public of the County or City of Wake County and State aforesaid, certify that Harvey L. Montague, III personally came before me this day and acknowledged that he is the Manager of Weller Developers, LLC, a North Carolina limited liability company, and that by authority duly given and as the act of such entity, he signed the foregoing instrument in its name on its behalf as its act and deed. Witness my hand and Notarial stamp or seal, this 14 day of February, 2023.

My Commission Expires: June 11, 2023
(Affix Seal)

Ellen M Haynes
Ellen M. Haynes Notary Public
Notary's Printed or Typed Name

Ellen M. Haynes
NOTARY PUBLIC
Wake County
North Carolina
My Commission Expires June 11, 2023

EXHIBIT A

All that certain lot or parcel of land situated in Harnett County, North Carolina and more particularly described as follows:

BEING all of Lots 1 through 89, inclusive, Wellers Knoll Subdivision, as shown on that plat entitled "Owned, Surveyed, and Mapped for: Weller Developments, LLC" recorded in Plat Book 2023, Pages 59-62, Harnett County Registry, to which reference is made for a more particular description.

EXHIBIT B

1. Taxes for the year 2023, and subsequent years, not yet due and payable.

2. Any right, easement, setback, interest, claim, encroachment, encumbrance, violation, variation, or other adverse circumstance affecting the Title disclosed by that lot combination plat(s) recorded in Plat Book 2023, Pages 59-62 and in Plat Book 2022, Page 243, of record in the Harnett County, North Carolina Registry.

3. Any discrepancy, conflict, access, shortage in area or boundary lines, encroachment, encumbrance, violation, variation, overlap, setback, easement or claims of easement, riparian right, and title to land within roads, ways, railroads, watercourses, burial grounds, marshes, dredged or filled areas or land below the mean highwater mark or within the bounds of any adjoining body of water, or other adverse circumstance affecting the Title that would be disclosed by a current inspection and accurate and complete land survey of the Land.

4. Easement(s) to CP&L recorded in Book 293, Page 278 and Book 293, Page 332, Harnett County Registry.

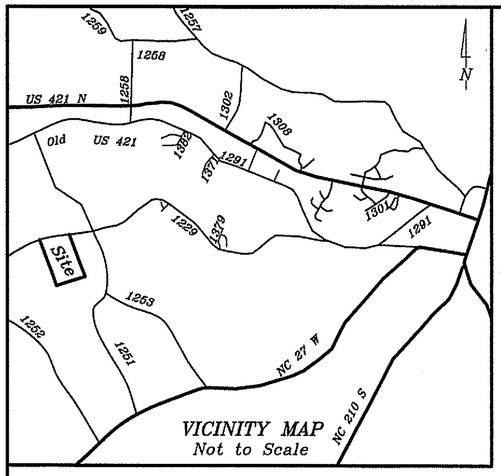
5. Easement to Duke Energy Process, LLC recorded in Book 4177, Page 1566, Harnett County Registry.

6. Declaration of Covenants, Conditions, Restrictions, Easements, Charges and Liens for Wellers Knoll recorded in Book _4183_, Page _532_, Harnett County Registry.

Exhibit C

Lot Number	PIN
Lot 1	0529-79-8090
Lot 2	0529-78-9910
Lot 3	0529-78-9840
Lot 4	0529-78-9790
Lot 5	0529-78-9534
Lot 6	0529-78-6249
Lot 7	0529-78-6531
Lot 8	0529-78-6624
Lot 9	0529-78-5783
Lot 10	0529-78-5842
Lot 11	0529-89-5155
Lot 12	0529-89-4154
Lot 13	0529-89-3143
Lot 14	0529-89-2009
Lot 15	0529-88-1869
Lot 16	0529-88-2743
Lot 17	0529-88-4801
Lot 18	0529-88-5814
Lot 19	0529-88-6824
Lot 20	0529-88-7692
Lot 21	0529-88-6681
Lot 22	0529-88-5680
Lot 23	0529-88-4588
Lot 24	0529-88-3586
Lot 25	0529-88-2581
Lot 26	0529-88-1495
Lot 27	0529-88-1400
Lot 28	0529-88-0314
Lot 29	0529-78-9225
Lot 30	0529-78-8175
Lot 31	0529-78-8043
Lot 32	0529-77-7976
Lot 33	0529-77-9609
Lot 34	0529-87-0707
Lot 35	0529-87-0876
Lot 36	0529-87-1937
Lot 37	0529-88-1098
Lot 38	0529-88-2176
Lot 39	0529-88-3260
Lot 40	0529-88-5218
Lot 41	0529-88-6320
Lot 42	0529-88-7331
Lot 43	0529-88-8334
Lot 44	0529-88-9339
Lot 45	0529-88-9139
Lot 46	0529-88-9059
Lot 47	0529-87-9979
Lot 48	0529-87-9899
Lot 49	0529-97-0717
Lot 50	0529-87-8676
Lot 51	0529-87-7753
Lot 52	0529-87-6735
Lot 53	0529-87-7921
Lot 54	0529-88-7003

Lot 55	0529-88-6162
Lot 56	0529-88-3092
Lot 57	0529-87-3992
Lot 58	0529-87-3882
Lot 59	0529-87-3742
Lot 60	0529-87-2694
Lot 61	0529-87-2526
Lot 62	0529-87-1531
Lot 63	0529-87-0418
Lot 64	0529-87-0284
Lot 65	0529-87-2158
Lot 66	0529-87-3288
Lot 67	0529-87-4373
Lot 68	0529-87-5437
Lot 69	0529-87-6337
Lot 70	0529-87-7354
Lot 71	0529-87-8396
Lot 72	0529-97-0403
Lot 73	0529-97-2418
Lot 74	0529-97-2653
Lot 75	0529-97-2796
Lot 76	0529-97-2990
Lot 77	0529-98-3012
Lot 78	0529-98-2192
Lot 79	0529-98-2294
Lot 80	0529-98-2364
Lot 81	0529-98-2413
Lot 82	0529-98-1532
Lot 83	0529-98-0672
Lot 84	0529-98-0701
Lot 85	0529-98-2608
Lot 86	0529-88-9952
Lot 87	0529-99-0054
Lot 88	0529-89-9211
Lot 89	0529-89-7136



LEGEND:

———	Lines Surveyed	TP	Telephone Pedestal
— — —	Lines Not Surveyed	WV▪	Water Valve
— — —	Tie or Adjoining Lines	WM●	Water Meter
- - - -	Right of Way Lines	FH◊	Fire Hydrant
EIP/EIS	Existing Iron Pipe or Stake	Esmt.	Easement
ECM	Existing Concrete Monument	R/W	Right-of-Way
EPK	Existing P.K. Nail	C/L	Centerline
PKS	P.K. Nail Set	P.C.	Plat Cabinet
EMN	Existing MAG Nail	D.B.	Deed Book
MNS	MAG Nail Set	P.B.	Plat Book
ISS	Iron Stake Set	B.M.	Book of Maps
CSS	Cotton Spindle Set	PIN	Parcel Identifier Number
ECS	Existing Cotton Spindle		
RRS	Railroad Spike	Ac.	Acres
ELS	Existing Lightwood Stake	Sq. Ft.	square feet
PP	Power Pole	CP	Computed Point
OHE	Overhead Electric Lines	[ ]	Street Address

N.C.G.S. North Carolina Geodetic Survey
NAD 27 North American Datum of 1927
NAD 83 North American Datum of 1983

NOTES:
* Iron Stakes set at all property corners unless noted otherwise.
* Areas determined by coordinate method.
* All distances/dimensions are Horizontal ground distances unless otherwise indicated.

I, Thomas Lester Stancil, certify that this plat was drawn under my supervision from (an actual survey made under my supervision) (deed description recorded in Book See , Page Ref. , etc.) (other); that the boundaries not surveyed are shown clearly indicated as drawn from information found in references as shown hereon; that the ratio of precision as calculated is 1:10000+; that this plat was prepared in accordance with G.S. 47-30 as amended.
Witness my original signature, registration number and seal this the the 16th day of April , A.D. 2021.

NORTH CAROLINA PROFESSIONAL SEAL L-1512 LAND SURVEYOR Thomas Lester Stancil

4-07-23

Surveyor

L-1512

License Number

I hereby certify that this survey creates a subdivision of land within the area of Harnett County, NC, which has an ordinance that regulates parcels of land.

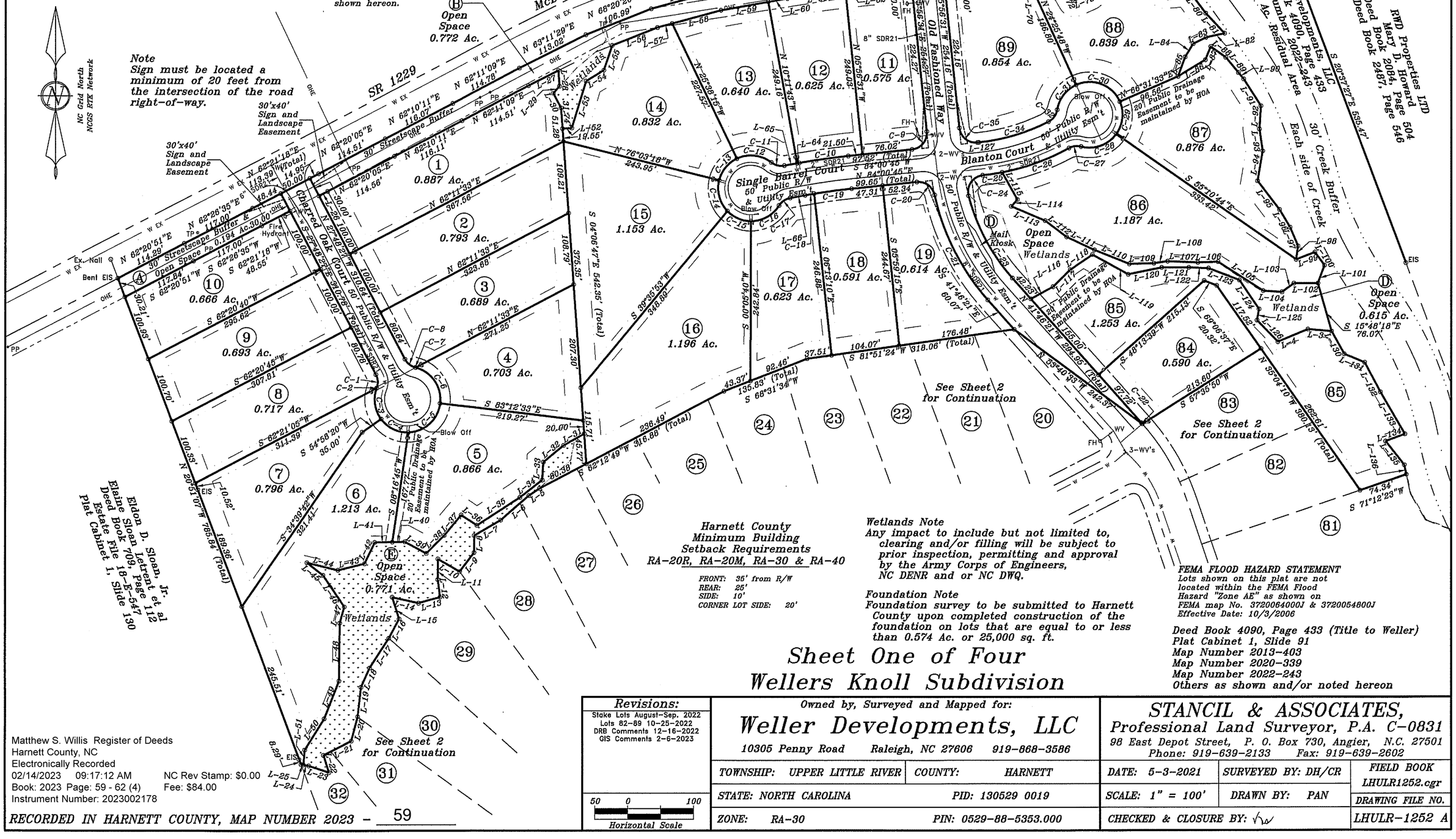
Thomas Lester Stancil, P.L.S.

See Sheets Two, Three, Four for additional seals, signatures, statements, notes, references, certifications, line tables etc...

NOTE:
A 10' x 70' Sight Triangle shall be placed at all street intersections as shown hereon.

Note
Sign must be located a minimum of 20 feet from the intersection of the road right-of-way.

NC Grid North NCGS RTK Network



Harnett County Minimum Building Setback Requirements RA-20R, RA-20M, RA-30 & RA-40

FRONT:	35' from R/W
REAR:	25'
SIDE:	10'
CORNER LOT SIDE:	20'

Wetlands Note
Any impact to include but not limited to, clearing and/or filling will be subject to prior inspection, permitting and approval by the Army Corps of Engineers, NC DENR and or NC DWQ.

Foundation Note
Foundation survey to be submitted to Harnett County upon completed construction of the foundation on lots that are equal to or less than 0.574 Ac. or 25,000 sq. ft.

FEMA FLOOD HAZARD STATEMENT
Lots shown on this plat are not located within the FEMA Flood Hazard "Zone AE" as shown on FEMA map No. 3720064000J & 3720054800J Effective Date: 10/3/2006

Deed Book 4090, Page 433 (Title to Weller)
Plat Cabinet 1, Slide 91
Map Number 2013-403
Map Number 2020-339
Map Number 2022-243
Others as shown and/or noted hereon

Sheet One of Four
Wellers Knoll Subdivision

Revisions:
Stake Lots August-Sep. 2022
Lots 82-89 10-25-2022
DRB Comments 12-16-2022
GIS Comments 2-6-2023

50 0 100
Horizontal Scale

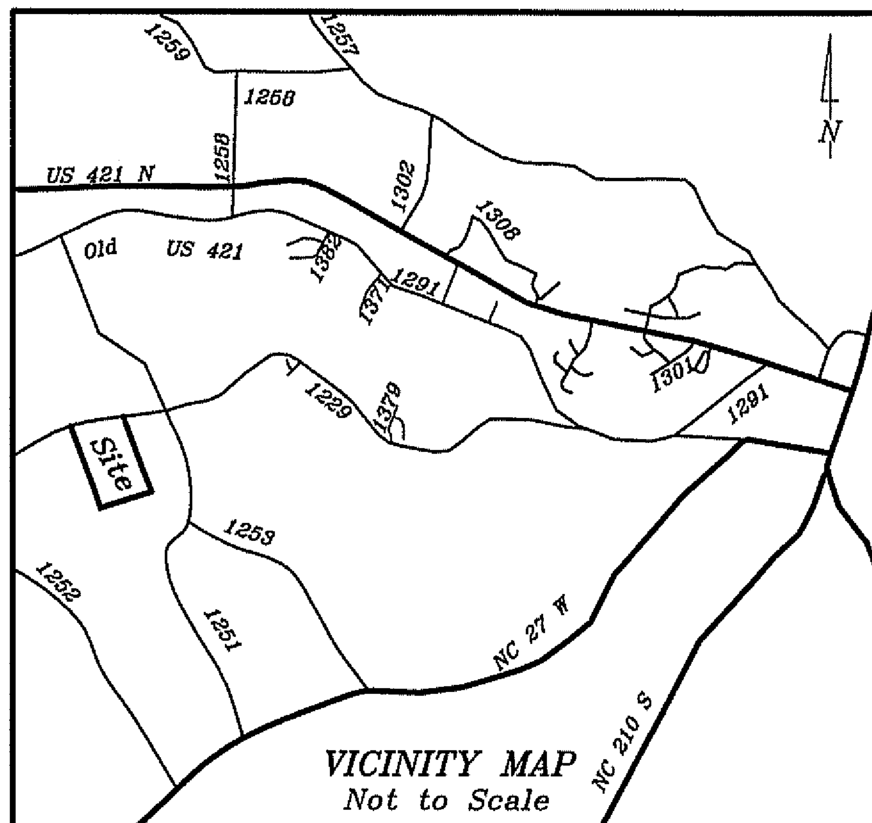
Owned by, Surveyed and Mapped for:
Weller Developments, LLC
10305 Penny Road Raleigh, NC 27606 919-868-3586

STANCIL & ASSOCIATES,
Professional Land Surveyor, P.A. C-0831
98 East Depot Street, P. O. Box 730, Angier, N.C. 27501
Phone: 919-639-2133 Fax: 919-639-2602

TOWNSHIP: UPPER LITTLE RIVER	COUNTY: HARNETT	
STATE: NORTH CAROLINA	PID: 130529 0019	
ZONE: RA-30	PIN: 0529-88-5353.000	
DATE: 5-3-2021	SURVEYED BY: DH/CR	FIELD BOOK LHULR1252.cgr
SCALE: 1" = 100'	DRAWN BY: PAN	DRAWING FILE NO.
CHECKED & CLOSURE BY: √√		LHULR-1252 A

Matthew S. Willis Register of Deeds
Harnett County, NC
Electronically Recorded
02/14/2023 09:17:12 AM NC Rev Stamp: $0.00
Book: 2023 Page: 59 - 62 (4) Fee: $84.00
Instrument Number: 2023002178

RECORDED IN HARNETT COUNTY, MAP NUMBER 2023 - 59



LEGEND:

———	Lines Surveyed
———	Lines Not Surveyed
— — —	Tie or Adjoining Lines
— — —	Right of Way Lines
EIP/EIS	Existing Iron Pipe or Stake
ECM	Existing Concrete Monument
EPK	Existing P.K. Nail
PKS	P.K. Nail Set
EMN	Existing MAG Nail
MNS	MAG Nail Set
ISS	Iron Stake Set
CSS	Cotton Spindle Set
ECS	Existing Cotton Spindle
RRS	Railroad Spike
ELS	Existing Lightwood Stake
PP	Power Pole
OHE	Overhead Electric Lines
TP	Telephone Pedestal
WV	Water Valve
WM	Water Meter
FH	Fire Hydrant
Esmt.	Easement
R/W	Right-of-Way
C/L	Centerline
P.C.	Plat Cabinet
D.B.	Deed Book
P.B.	Plat Book
B.M.	Book of Maps
PIN	Parcel Identifier Number
Ac.	Acres
Sq. Ft.	square feet
CP	Computed Point
[ ]	Street Address

N.C.G.S. North Carolina Geodetic Survey
NAD 27 North American Datum of 1927
NAD 83 North American Datum of 1983

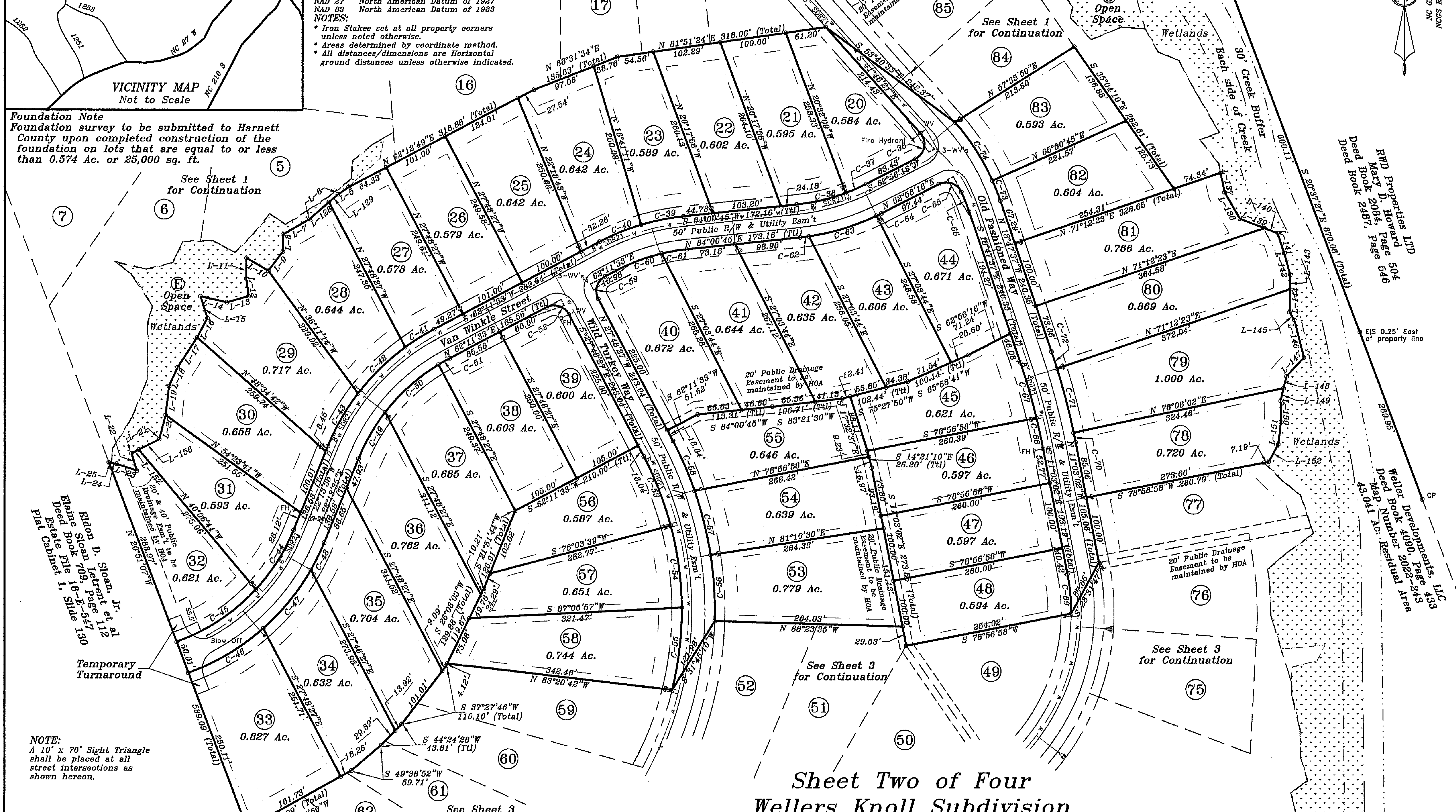
NOTES:
* Iron Stakes set at all property corners unless noted otherwise.
* Areas determined by coordinate method.
* All distances/dimensions are Horizontal ground distances unless otherwise indicated.

NORTH CAROLINA PROFESSIONAL LAND SURVEYOR SEAL L-... Thomas Lester Stancil 02-07-23

See Sheets One, Three, Four for additional seals, signatures, statements, notes, certifications, line and curve tables etc...

Wetlands Note
Any impact to include but not limited to, clearing and/or filling will be subject to prior inspection, permitting and approval by the Army Corps of Engineers, NC DENR and or NC DWQ.

Foundation Note
Foundation survey to be submitted to Harnett County upon completed construction of the foundation on lots that are equal to or less than 0.574 Ac. or 25,000 sq. ft.



NOTE:
A 10' x 70' Sight Triangle shall be placed at all street intersections as shown hereon.

FEMA FLOOD HAZARD STATEMENT
Lots shown on this plat are not located within the FEMA Flood Hazard "Zone AE" as shown on FEMA map No. 3720064000J & 3720054800J
Effective Date: 10/3/2006

Sheet Two of Four
Wellers Knoll Subdivision

Revisions:
Stake Lots August-Sep. 2022
Lots 82-85 10-25-2022
DRB Comments 12-16-2022
GIS Comments 2-6-2023

Owned by, Surveyed and Mapped for:
Weller Developments, LLC
10305 Penny Road Raleigh, NC 27606 919-868-3586

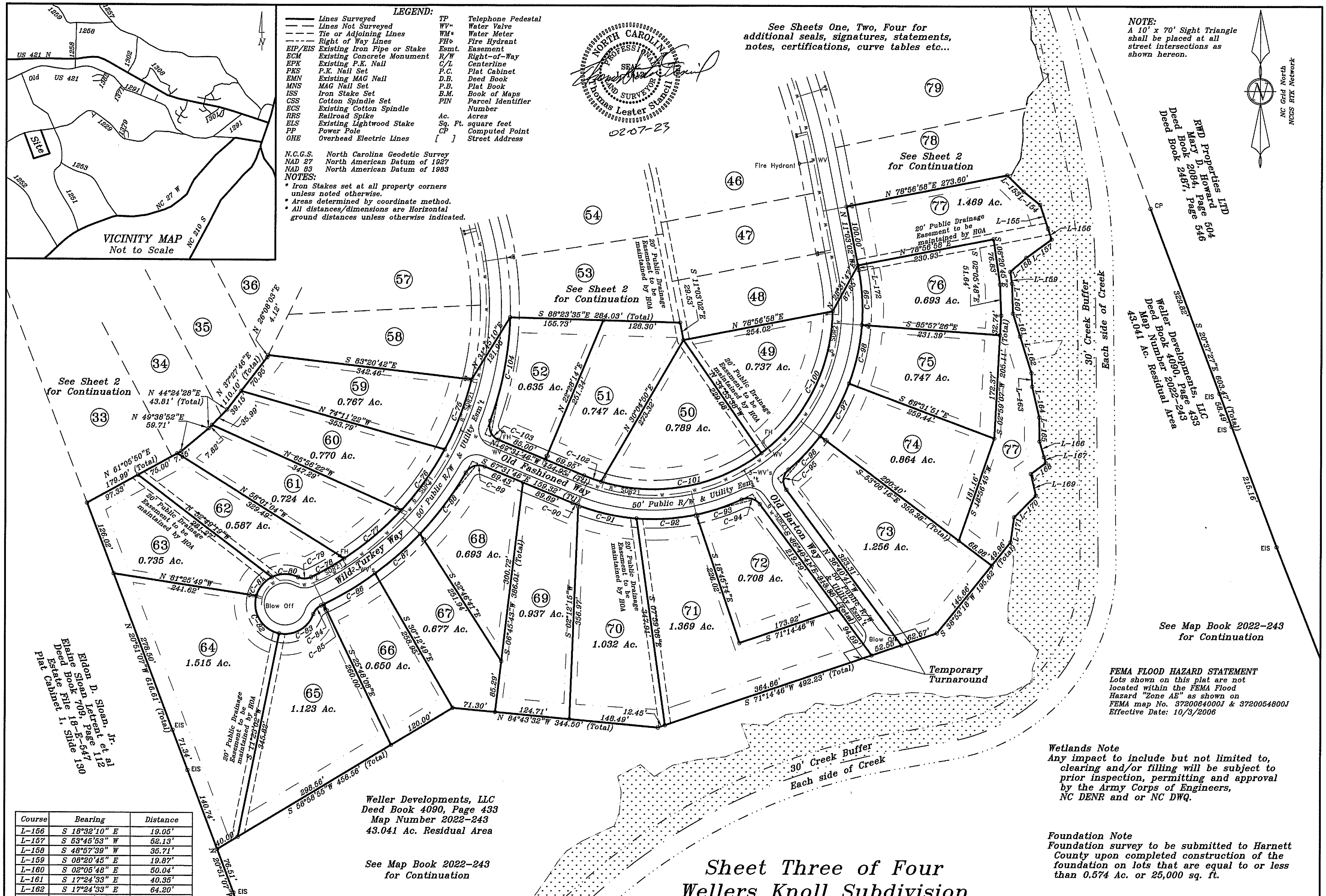
STANCIL & ASSOCIATES,
Professional Land Surveyor, P.A. C-0831
98 East Depot Street, P. O. Box 730, Angier, N.C. 27501
Phone: 919-639-2133 Fax: 919-639-2602

TOWNSHIP: UPPER LITTLE RIVER	COUNTY: HARNETT	DATE: 5-3-2021	SURVEYED BY: DH/CR
STATE: NORTH CAROLINA	PID: 130529 0019	SCALE: 1" = 100'	DRAWN BY: PAN
ZONE: RA-30	PIN: 0529-88-5353.000	CHECKED & CLOSURE BY:	

FIELD BOOK LHULR1252.cgr
DRAWING FILE NO. LHULR-1252 B

50 0 100 Horizontal Scale

RECORDED IN HARNETT COUNTY, MAP NUMBER 2023 - 60


VICINITY MAP
Not to Scale
US 421 N
Old US 421
Site
NC 27 W
NC 210 S
LEGEND:
Lines Surveyed
Lines Not Surveyed
Tie or Adjoining Lines
Right of Way Lines
EIP/EIS Existing Iron Pipe or Stake
ECM Existing Concrete Monument
EPK Existing P.K. Nail
PKS P.K. Nail Set
EMN Existing MAG Nail
MNS MAG Nail Set
ISS Iron Stake Set
CSS Cotton Spindle Set
ECS Existing Cotton Spindle
RRS Railroad Spike
ELS Existing Lightwood Stake
PP Power Pole
OHE Overhead Electric Lines
TP Telephone Pedestal
WV Water Valve
WM Water Meter
FH Fire Hydrant
Esmt. Easement
R/W Right-of-Way
C/L Centerline
P.C. Plat Cabinet
D.B. Deed Book
P.B. Plat Book
B.M. Book of Maps
PIN Parcel Identifier Number
Ac. Acres
Sq. Ft. square feet
CP Computed Point
[ ] Street Address
N.C.G.S. North Carolina Geodetic Survey
NAD 27 North American Datum of 1927
NAD 83 North American Datum of 1983
NOTES:
* Iron Stakes set at all property corners unless noted otherwise.
* Areas determined by coordinate method.
* All distances/dimensions are Horizontal ground distances unless otherwise indicated.
See Sheets One, Two, Four for additional seals, signatures, statements, notes, certifications, curve tables etc...
NOTE: A 10' x 70' Sight Triangle shall be placed at all street intersections as shown hereon.
NC Grid North NCGS RTK Network
RWD Properties LTD Mary D. Howard Deed Book 2084, Page 504 Deed Book 2467, Page 546
Weller Developments, LLC Deed Book 4090, Page 433 Map Number 2022-243 43.041 Ac. Residual Area
See Sheet 2 for Continuation
Old Fashioned Way
Old Barton Way
Wild Turkey Way
50' Public R/W & Utility Esm't
20' Public Drainage Easement to be maintained by HOA
30' Creek Buffer Each side of Creek
Temporary Turnaround
Blow Off
Fire Hydrant
Eldon D. Sloan, Jr. Elaine Sloan Letrent et al Deed Book 709, Page 112 Estate File 18-E-547 Plat Cabinet 1, Slide 130
49 0.737 Ac.
50 0.789 Ac.
51 0.747 Ac.
52 0.635 Ac.
59 0.767 Ac.
60 0.770 Ac.
61 0.724 Ac.
62 0.587 Ac.
63 0.735 Ac.
64 1.515 Ac.
65 1.123 Ac.
66 0.650 Ac.
67 0.677 Ac.
68 0.693 Ac.
69 0.937 Ac.
70 1.032 Ac.
71 1.369 Ac.
72 0.708 Ac.
73 1.256 Ac.
74 0.864 Ac.
75 0.747 Ac.
76 0.693 Ac.
77 1.469 Ac.
See Map Book 2022-243 for Continuation
FEMA FLOOD HAZARD STATEMENT
Lots shown on this plat are not located within the FEMA Flood Hazard "Zone AE" as shown on FEMA map No. 3720064000J & 3720054800J Effective Date: 10/3/2006
Wetlands Note
Any impact to include but not limited to, clearing and/or filling will be subject to prior inspection, permitting and approval by the Army Corps of Engineers, NC DENR and or NC DWQ.
Foundation Note
Foundation survey to be submitted to Harnett County upon completed construction of the foundation on lots that are equal to or less than 0.574 Ac. or 25,000 sq. ft.

Course	Bearing	Distance
L-156	S 18°32'10" E	19.05'
L-157	S 53°45'53" W	52.13'
L-158	S 48°57'39" W	35.71'
L-159	S 08°20'45" E	19.87'
L-160	S 02°05'48" E	50.04'
L-161	S 17°24'33" E	40.35'
L-162	S 17°24'33" E	64.20'
L-163	S 03°10'37" E	22.32'
L-164	S 13°15'15" E	52.42'
L-165	S 00°52'16" E	40.08'
L-166	S 16°07'48" E	27.28'
L-167	S 16°07'48" E	10.33'
L-168	S 53°23'41" W	30.92'
L-169	S 13°18'34" E	37.01'
L-170	S 45°01'28" W	51.38'
L-171	S 07°50'39" W	42.48'
L-172	N 11°03'02" W	8.13'

Sheet Three of Four
Wellers Knoll Subdivision

Revisions:
Stake Lots August-Sep. 2022
Lots 74-77 10-25-2022
DRB Comments 12-16-2022
GIS Comments 2-6-2023

50 0 100
Horizontal Scale

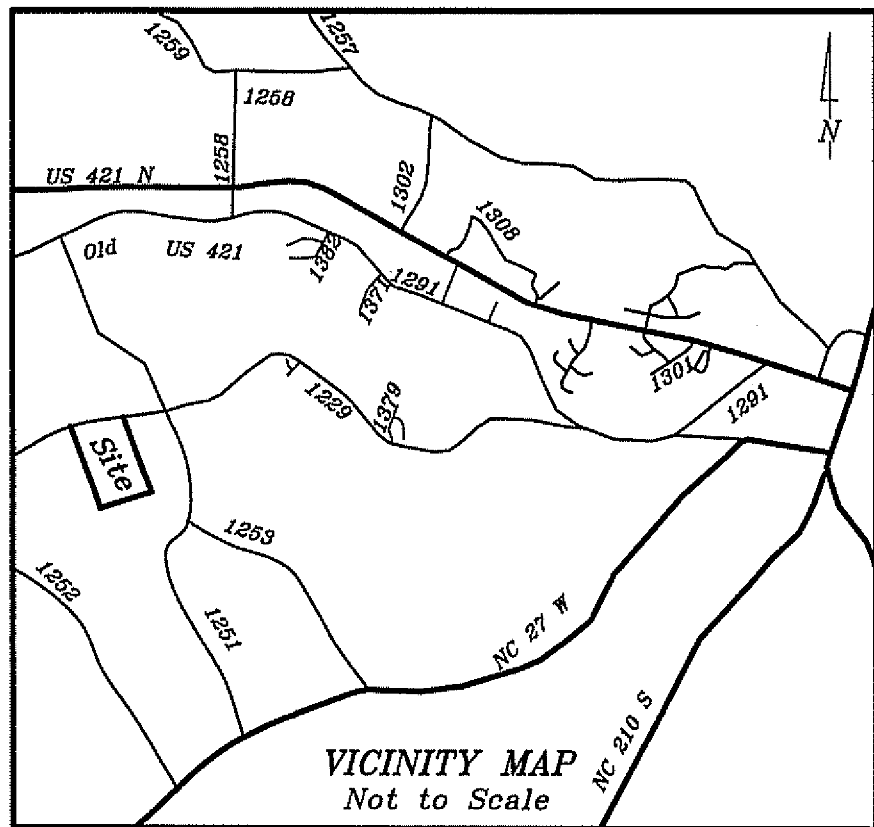
Owned by, Surveyed and Mapped for:
Weller Developments, LLC
10305 Penny Road Raleigh, NC 27606 919-868-3586

STANCIL & ASSOCIATES,
Professional Land Surveyor, P.A. C-0831
98 East Depot Street, P. O. Box 730, Angier, N.C. 27501
Phone: 919-639-2133 Fax: 919-639-2602

TOWNSHIP: UPPER LITTLE RIVER	COUNTY: HARNETT	DATE: 5-3-2021	SURVEYED BY: DH/CR
STATE: NORTH CAROLINA	PID: 130529 0019	SCALE: 1" = 100'	DRAWN BY: PAN
ZONE: RA-30	PIN: 0529-88-5353.000	CHECKED & CLOSURE BY:	

FIELD BOOK LHULR1252.cgr
DRAWING FILE NO. LHULR-1252 C

RECORDED IN HARNETT COUNTY, MAP NUMBER 2023 - 61



Certificate of Ownership and Dedication

I (we)hereby certify that I am(we are)the owner(s) or agent of the property shown and described hereon, which is located in the subdivision jurisdiction of Harnett County, North Carolina and that I (we) hereby adopt this plan of subdivision with my (our) free consent and establish minimum building setback lines, dedicate all streets, alleys, walks, parks and/or other sites and easements to public or private use as noted. Furthermore, I (we) dedicate all sanitary sewer and/or water lines to the County of Harnett.

2/13/2023 — DocuSigned by: [signature]

Date — Owner

Public Plat Dedication

All roads in this subdivision are hereby declared public. The maintenance of all streets and roads in this subdivision shall be the responsibility of Weller Developments, LLC and it shall be their responsibility to bring such streets up to the standards of the North Carolina Department of Transportation before any streets on this plat are added to the North Carolina State Highway System. If the District Engineer has not recommended that the N. C. Department of Transportation accept maintenance responsiblity for the required public road improvements by the time that the County has issued building permits for seventy-five percent (75%) of the lots shown on the record plat, the County shall not issue any more building permits until the District Engineer makes such a recommendation and formally notifies the Subdivision Administrator.

2/13/2023 — DocuSigned by: [signature]

Date — Owner or Agent

Stormwater Certificate

I (we)hereby certify that stormwater conveyance and control measures have been completed in accordance with the approved plans and specifications to the best of our abilities. Due care and diligence were used in observation and construction such that construction was observed to be built within substantial compliance of the permit and other supporting materials.

2/14/2023 — DocuSigned by: Spencer B. Terry, III

Date — Engineer of Record

State of North Carolina
County of Harnett

I, Michele Temple, Review Officer of Harnett County, certify that the map or plat to which this certification is affixed meets all statutory requirements for recording.

Michele Temple — 2/14/2023

Review Officer — Date

State of North Carolina
County of Harnett

I hereby certify that the development hereon has been granted final approval by the Harnett County Development Review Board pursuant to the regulations set forth by E-911 Addressing, Environmental Health, Fire Marshall, Planning, and Public Utilities of Harnett County, N.C., subject to recordation in the Harnett County Office of Register of Deeds within thirty days of the date below.

DocuSigned by: Meade O. Bradshaw, III — 2/14/2023

Development Review Board Chairman — Date

DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PROPOSED SUBDIVISION ROAD
DESIGN STANDARDS CERTIFICATION

APPROVED Cee R. Hines Sr P.E. CJ
DISTRICT ENGINEER

DATE: 2-13-2023

ONLY NCDOT APPROVED STRUCTURES ARE TO BE CONSTRUCTED ON PUBLIC RIGHT-OF-WAY

ALL LOTS SHALL BE SERVED BY THE INTERNAL STREET SYSTEM ONLY.

THE 10' X 70' SIGHT TRIANGLES TAKES PRECEDENCE OVER ANY SIGN EASEMENTS.

NOTE:
ALL DRAINAGE EASEMENTS SHALL BE DEDICATED AS PUBLIC AND IT SHALL BE THE RESPONSIBILITY OF THE PROPERTY OWNERS TO MAINTAIN THE DRAINAGE EASEMENTS AND ANY DRAINAGE STRUCTURES THEREIN, SO AS TO MAINTAIN THE INTEGRITY OF THE DRAINAGE SYSTEM AND INSURE POSITIVE DRAINAGE.

A 15' CONSTRUCTION EASEMENT SHALL BE RESERVED ON BOTH SIDES OF ALL PROPOSED STREETS.

THE OWNER, DEVELOPER, OR CONTRACTOR SHALL SET THE CENTERLINE OF THE EXISTING ROADWAY DITCH BACK TO A MINIMUM OF 12 FEET FROM THE EXISTING /PROPOSED EDGE OF PAVEMENT ALONG ALL ROAD FRONT LOTS.

NORTH CAROLINA PROFESSIONAL SEAL L-1612 LAND SURVEYOR Thomas Lester Stancil
02-07-23

See Sheets One, Three, Four for additional seals, signatures, statements, notes, certifications, curve tables etc...

Curve	Radius	Length	Delta	Chord	Chord Bear.
C-1	25.00'	21.03'	48°11'23"	20.41'	S 03°42'46" E
C-2	50.00'	0.32'	0°21'57"	0.32'	S 20°11'57" W
C-3	50.00'	49.29'	56°29'05"	47.32'	S 08°13'33" E
C-4	50.00'	48.06'	55°04'20"	46.23'	S 64°00'16" E
C-5	50.00'	71.27'	81°40'07"	65.39'	N 47°37'31" E
C-6	50.00'	71.73'	82°12'08"	65.74'	N 34°18'37" W
C-7	50.00'	0.51'	0°35'09"	0.51'	N 75°42'15" W
C-8	25.00'	21.03'	48°11'23"	20.41'	N 51°54'08" W
C-9	25.00'	39.25'	89°57'16"	35.34'	S 39°02'07" W
C-10	1025.00	75.26'	4°12'26"	75.26'	S 81°54'31" W
C-11	25.00'	21.03'	48°11'23"	20.41'	N 76°06'02" W
C-12	50.00'	55.53'	63°37'55"	52.72'	N 83°49'18" W

Site Data and Notes

Property shown hereon is not located in a watershed district.
All lots are limited to 7000 sq. ft. of impervious surface
Property shown hereon is located in Medium Density Residential Future Land Use.
NO lot shall have direct access to SR 1229 (McDougald Road)
78.063 Ac. In Entire Subdivision
93 Lots planned in development = 1.2 DUA
Minimum lot size in = 0.575 Ac. or 25,041 sq. ft.
Maximum lot size = 1.515 Ac. or 66,007 sq. ft.
Dedicated Open Space = 2.618 Ac.
All streets shown hereon are to be 50' Public Dedicated R/W and 50' Utility Easements.
All construction shall be in accordance with Harnett County and/or NC DOT Standards.
All lots shall be served by Harnett County Municipal Water and Individual Septic Systems.
Sidewalks, street trees, streetscape buffer , mailbox kiosk, sign easements, pedestrian trail, etc... shall be maintained by the Home Owners Association ("HOA"), Property Owners Association, ("POA"), Condominium Owner's Association ("COA"), or any other association responsible for the maintenance and/or upkeep of the residential community. Maintenance shall be enforced by the restrictive covenats. Sidewalk, street trees, or streetscape buffers that are damaged or removed by Harnett County/ Department of Public Utilities/Harnett Regional Water or its representatives, agents, contractors as a result of repair/maintenance of the public water and/or sewer line will be replace or repaired by the Home Owners Association ("HOA"), Property Owners Association, ("POA"), Condominium Owner's Association ("COA") or any other association responsible for the maintenance and/or upkeep of the residential community.
All Drainage easements are to be permanent & public. The maintenance of all said drainage easements shall be responsibility of the HOA, POA or COA
Fire Hydrants and Street Lights shall be installed per Harnett County Regulations.
This development is within one mile of a Voluntary Agricultural District.
Foundation survey to be submitted to Harnett County upon completed construction of the foundation on lots that are equal to or less than 0.574 Ac. or 25,000 sq. ft.

Course	Bearing	Distance	Course	Bearing	Distance
L-1	N 84°03'29" E	25.94'	L-79	N 85°10'48" E	35.97'
L-2	N 84°08'08" E	24.06'	L-80	S 36°45'45" E	43.64'
L-3	N 85°07'09" W	36.15'	L-81	S 43°22'20" E	42.05'
L-4	S 67°15'19" W	49.42'	L-82	S 77°42'41" W	29.02'
L-5	S 56°01'39" W	19.43'	L-83	S 63°04'05" W	21.79'
L-6	S 49°03'54" W	56.66'	L-84	S 31°35'51" W	23.30'
L-7	S 59°55'07" W	46.53'	L-85	S 20°10'28" W	31.30'
L-8	S 00°38'16" W	25.82'	L-86	N 58°45'25" E	48.51'
L-9	S 37°08'47" W	36.06'	L-87	N 22°25'44" E	21.45'
L-10	N 60°04'30" W	38.23'	L-88	S 55°05'14" E	27.91'
L-11	S 00°22'40" W	31.13'	L-89	S 39°35'25" E	30.13'
L-12	S 07°32'08" E	26.74'	L-90	S 39°35'25" E	12.56'
L-13	S 74°09'18" W	33.93'	L-91	S 32°45'15" E	48.62'
L-14	N 77°24'53" W	41.16'	L-92	S 03°33'55" W	35.31'
L-15	S 17°33'26" E	34.46'	L-93	S 08°24'50" E	33.42'
L-16	S 27°41'29" W	33.18'	L-94	S 09°39'44" W	46.02'
L-17	S 32°54'26" W	54.00'	L-95	S 37°33'23" E	55.03'
L-18	S 24°21'14" W	31.47'	L-96	S 30°42'41" E	31.36'
L-19	S 06°50'06" W	44.28'	L-97	S 22°55'54" E	31.08'
L-20	S 14°45'16" W	37.64'	L-98	S 07°54'20" W	20.50'
L-21	S 63°10'14" W	47.18'	L-99	N 69°09'34" E	30.61'
L-22	S 17°47'07" E	27.15'	L-100	S 36°22'54" E	24.57'
L-23	N 72°02'31" W	32.46'	L-101	S 20°02'18" W	28.80'
L-24	N 79°57'47" W	8.09'	L-102	S 89°54'31" W	36.59'
L-25	N 79°57'47" W	3.64'	L-103	S 53°51'05" W	22.44'
L-26	N 62°21'16" E	14.86'	L-104	N 86°22'48" W	28.74'
L-27	N 63°11'29" E	50.91'	L-105	N 57°29'27" W	61.45'
L-28	S 04°06'47" E	23.85'	L-106	S 88°08'36" W	30.78'
L-29	S 41°32'27" W	14.18'	L-107	N 87°45'06" W	45.88'
L-30	S 27°59'52" E	25.05'	L-108	S 61°59'36" W	21.23'
L-31	S 60°19'32" W	35.92'	L-109	S 86°16'49" W	37.20'
L-32	S 50°37'32" W	39.96'	L-110	N 68°26'53" W	57.26'
L-33	S 03°26'48" W	27.17'	L-111	N 64°50'47" W	46.82'
L-34	S 51°49'17" W	43.04'	L-112	N 52°48'44" W	41.06'
L-35	S 57°09'45" W	77.78'	L-113	N 67°01'08" W	55.83'
L-36	N 56°31'37" W	28.71'	L-114	N 41°10'09" E	13.76'
L-37	S 40°01'44" W	39.96'	L-115	N 29°19'59" W	47.30'
L-38	S 44°43'10" W	38.80'	L-116	N 61°28'50" E	38.24'
L-39	N 61°54'33" W	37.26'	L-117	N 45°24'25" E	36.80'
L-40	S 88°48'08" W	18.89'	L-118	N 55°55'10" E	40.87'
L-41	S 88°48'08" W	26.61'	L-119	S 61°23'04" E	62.17'
L-42	S 25°40'48" W	35.84'	L-120	N 76°19'29" E	51.92'
L-43	N 76°14'57" W	41.74'	L-121	N 89°53'19" E	41.25'
L-44	N 76°24'20" W	48.53'	L-122	S 87°41'55" E	30.00'
L-45	S 52°00'53" E	31.29'	L-123	S 69°06'37" E	50.37'
L-46	S 33°58'30" E	57.63'	L-124	S 34°07'26" E	53.26'
L-47	S 15°39'25" W	25.57'	L-125	S 10°01'51" W	17.22'
L-48	S 00°44'27" W	87.53'	L-126	S 44°04'10" E	45.72'
L-49	S 21°41'34" W	60.70'	L-127	S 84°00'45" W	2.12'
L-50	S 32°23'55" W	55.22'	L-128	N 49°03'54" E	38.84'
L-51	S 04°49'21" W	22.46'	L-129	N 49°03'54" E	17.82'
L-52	N 85°53'13" E	14.05'	L-130	S 29°05'25" E	39.76'
L-53	N 17°01'00" E	74.46'	L-131	S 67°46'47" E	33.60'
L-54	N 58°36'05" E	31.71'	L-132	S 28°01'46" E	50.80'
L-55	N 18°32'50" E	39.88'	L-133	S 30°12'36" E	74.09'
L-56	N 68°20'20" E	73.94'	L-134	S 69°31'50" W	31.18'
L-57	N 74°46'10" E	23.13'	L-135	S 38°17'30" E	45.82'
L-58	N 74°46'10" E	77.00'	L-136	S 12°06'45" E	14.61'
L-59	N 79°55'01" E	72.99'	L-137	S 12°06'45" E	30.08'
L-60	N 79°55'01" E	29.52'	L-138	S 30°16'08" E	45.88'
L-61	N 83°05'21" E	89.05'	L-139	S 69°05'18" E	39.39'
L-62	N 83°05'21" E	18.00'	L-140	S 69°05'18" E	21.54'
L-63	N 84°03'29" E	83.01'	L-141	S 18°14'06" E	31.96'
L-64	S 79°48'17" W	3.30'	L-142	S 15°55'35" E	33.71'
L-65	S 79°48'17" W	19.88'	L-143	S 01°05'03" W	21.92'
L-66	N 79°48'17" E	23.18'	L-144	S 01°05'03" W	34.63'
L-67	N 84°08'08" E	87.18'	L-145	S 32°09'29" E	13.42'
L-68	N 83°47'27" E	15.62'	L-146	S 14°20'31" E	58.77'
L-69	N 84°07'36" E	53.07'	L-147	S 42°24'11" W	38.69'
L-70	S 06°59'02" E	14.44'	L-148	S 13°25'09" W	16.55'
L-71	S 73°17'43" E	29.66'	L-149	S 13°25'09" W	19.41'
L-72	S 30°30'37" E	25.60'	L-150	S 01°05'43" E	32.18'
L-73	N 66°27'56" E	24.10'	L-151	S 07°02'00" W	34.01'
L-74	N 07°28'54" E	42.98'	L-152	S 29°08'40" W	30.02'
L-75	N 84°11'04" E	41.10'	L-153	S 45°32'11" E	38.30'
L-76	N 84°11'04" E	39.00'	L-154	S 51°25'55" E	35.62'
L-77	N 85°29'11" E	9.95'	L-155	S 18°32'10" E	41.65'
L-78	S 22°29'26" E	52.81'	L-156	S 63°10'14" W	34.71'
			L-157	S 63°10'14" W	12.46'

Curve	Radius	Length	Delta	Chord	Chord Bear.
C-13	50.00'	44.00'	50°25'03"	42.59'	S 39°09'13" W
C-14	50.00'	50.54'	57°54'59"	48.42'	S 15°00'48" E
C-15	50.00'	40.08'	45°56'02"	39.02'	S 66°56'19" E
C-16	50.00'	51.03'	58°28'46"	48.85'	N 60°51'17" E
C-17	25.00'	21.03'	48°11'23"	20.41'	N 55°42'36" E
C-18	975.00'	13.88'	0°48'57"	13.88'	N 80°12'46" E
C-19	975.00'	57.72'	3°23'31"	57.71'	N 82°19'00" E
C-20	25.00'	36.57'	83°49'21"	33.40'	S 54°04'34" E
C-21	350.00'	180.86'	29°36'27"	178.86'	S 26°58'07" E
C-22	350.00'	2.28'	00°22'24"	2.28'	N 41°35'09" W
C-23	300.00'	143.19'	27°20'50"	141.83'	N 28°05'56" W
C-24	25.00'	42.90'	98°16'46"	37.83'	N 34°43'53" E
C-25	350.00'	29.87'	4°53'24"	29.86'	N 81°26'35" E
C-26	350.00'	108.62'	17°46'54"	108.19'	N 70°06'26" E
C-27	25.00'	19.09'	43°45'42"	18.63'	N 83°05'50" E
C-28	50.00'	60.43'	69°15'12"	56.82'	N 70°21'06" E
C-29	50.00'	45.00'	51°33'58"	43.50'	N 09°56'30" E
C-30	50.00'	55.00'	63°01'31"	52.27'	N 47°21'14" W
C-31	50.00'	80.42'	92°09'01"	72.03'	S 55°03'29" W
C-32	25.00'	23.47'	53°46'42"	22.61'	S 35°52'20" W
C-33	DELETED				
C-34	300.00'	111.27'	21°15'04"	110.63'	S 73°23'13" W
C-35	25.00'	39.29'	90°02'44"	35.37'	N 50°57'53" W
C-36	25.00'	45.69'	104°42'36"	39.59'	S 10°34'58" W
C-37	300.00'	34.17'	6°31'36"	34.15'	S 66°12'04" W
C-38	300.00'	76.17'	14°32'54"	75.97'	S 76°44'18" W
C-39	350.00'	65.36'	10°41'56"	65.26'	S 78°39'47" W
C-40	350.00'	67.93'	11°07'16"	67.83'	S 67°45'11" W
C-41	350.00'	51.92'	8°29'58"	51.87'	S 57°56'34" W
C-42	350.00'	100.34'	16°25'35"	100.00'	S 45°28'47" W
C-43	350.00'	91.87'	15°02'24"	91.61'	S 29°44'47" W
C-44	300.00'	107.16'	20°28'14"	106.61'	S 32°27'46" W
C-45	300.00'	144.81'	27°39'27"	143.41'	S 56°31'30" W
C-46	350.00'	132.36'	21°40'02"	131.57'	N 59°20'55" E
C-47	350.00'	114.63'	18°45'55"	114.12'	N 39°07'56" E
C-48	350.00'	45.96'	7°31'23"	45.92'	N 25°59'17" E
C-49	300.00'	80.95'	15°27'35"	80.70'	N 29°57'23" E
C-50	300.00'	108.86'	20°47'29"	108.27'	N 48°04'55" E
C-51	300.00'	19.45'	3°42'54"	19.45'	N 60°20'06" E
C-52	25.00'	39.27'	90°00'00"	35.36'	S 72°48'27" E
C-53	500.00'	112.30'	12°52'06"	112.06'	S 21°22'24" E
C-54	500.00'	125.33'	14°21'41"	125.00'	S 07°45'30" E
C-55	500.00'	125.33'	14°21'41"	125.00'	S 06°36'11" W
C-56	550.00'	100.14'	10°25'55"	100.00'	N 03°36'33" W
C-57	550.00'	100.14'	10°25'55"	100.00'	N 14°02'27" W
C-58	550.00'	82.08'	8°33'03"	82.01'	N 23°31'56" W
C-59	25.00'	39.27'	90°00'00"	35.36'	N 17°11'33" E
C-60	300.00'	75.74'	14°27'58"	75.54'	N 69°25'32" E
C-61	300.00'	38.51'	7°21'14"	38.48'	N 80°20'08" E
C-62	350.00'	13.45'	2°12'05"	13.45'	N 82°54'43" E
C-63	350.00'	107.07'	17°31'41"	106.66'	N 73°02'50" E
C-64	350.00'	8.22'	1°20'43"	8.22'	N 63°36'37" E
C-65	25.00'	40.21'	92°09'57"	36.02'	S 70°58'46" E
C-66	300.00'	31.95'	6°06'10"	31.94'	S 21°50'42" E
C-67	1000.00'	87.89'	5°02'09"	87.87'	S 16°16'33" E
C-68	1000.00'	47.25'	2°42'27"	47.25'	S 12°24'15" E
C-69	300.00'	59.98'	11°27'17"	59.88'	S 05°19'23" E
C-70	1050.00'	14.95'	0°48'56"	14.95'	N 11°27'30" W
C-71	1050.00'	100.01'	5°27'27"	99.97'	N 14°35'41" W
C-72	1050.00'	26.95'	1°28'13"	26.95'	N 18°03'31" W
C-73	350.00'	32.75'	5°21'38"	32.73'	N 21°28'26" W
C-74	350.00'	100.34'	16°25'35"	100.00'	N 32°22'03" W
C-75	500.00'	125.33'	14°21'41"	125.00'	S 20°57'53" W
C-76	500.00'	125.33'	14°21'41"	125.00'	S 35°19'34" W
C-77	500.00'	125.33'	14°21'41"	125.00'	S 49°41'16" W
C-78	500.00'	63.43'	7°16'07"	63.39'	S 60°30'10" W
C-79	25.00'	22.46'	51°28'43"	21.71'	S 89°52'35" W
C-80	25.00'	45.72'	52°23'26"	44.14'	S 89°25'14" W
C-81	50.00'	41.20'	47°12'41"	40.04'	S 39°37'11" W
C-82	50.00'	82.63'	94°41'23"	73.54'	S 31°19'51" E
C-83	50.00'	71.51'	81°56'31"	65.57'	N 60°21'12" E
C-84	25.00'	19.76'	45°20'24"	19.27'	N 42°03'08" E
C-85	550.00'	5.04'	0°31'28"	5.04'	N 64°27'36" E
C-86	550.00'	100.14'	10°25'55"	100.00'	N 58°58'55" E
C-87	550.00'	100.14'	10°25'55"	100.00'	N 48°33'00" E
C-88	550.00'	128.33'	13°22'08"	128.04'	N 36°38'59" E
C-89	25.00'	36.00'	82°30'19"	32.97'	N 71°13'04" E
C-90	350.00'	10.12'	1°39'22"	10.12'	S 68°21'27" E
C-91	350.00'	100.34'	16°25'35"	100.00'	S 77°23'55" E
C-92	350.00'	100.34'	16°25'35"	100.00'	N 86°10'29" E
C-93	350.00'	80.04'	13°06'10"	79.87'	N 71°24'37" E
C-94	25.00'	34.24'	78°27'47"	31.62'	S 75°54'34" E
C-95	25.00'	37.60'	86°10'39"	34.16'	N 06°24'39" E
C-96	350.00'	76.99'	12°36'14"	76.84'	N 43°11'51" E
C-97	350.00'	100.34'	16°25'35"	100.00'	N 28°40'57" E
C-98	350.00'	100.34'	16°25'35"	100.00'	N 12°15'21" E
C-99	350.00'	92.20'	15°05'35"	91.93'	N 03°30'14" W
C-100	300.00'	273.91'	52°18'46"	264.50'	S 26°33'39" W
C-101	300.00'	282.76'	54°00'13"	272.41'	S 79°43'10" W
C-102	300.00'	30.10'	5°44'57"	30.09'	N 70°24'15" E
C-103	25.00'	38.18'	87°30'29"	34.58'	N 23°46'32" E
C-104	550.00'	176.36'	18°22'18"	175.60'	N 10°47'34" E

Sheet Four of Four
Wellers Knoll Subdivision

Revisions:
Stake Lots August-Sep. 2022
Lots 82-89 10-25-2022
DRB Comments 12-16-2022

Owned by, Surveyed and Mapped for:

Weller Developments, LLC

10305 Penny Road Raleigh, NC 27606 919-868-3586

STANCIL & ASSOCIATES,

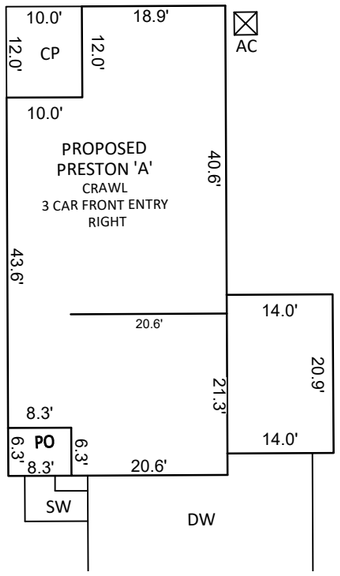
Professional Land Surveyor, P.A. C-0831
98 East Depot Street, P. O. Box 730, Angier, N.C. 27501
Phone: 919-639-2133 Fax: 919-639-2602

TOWNSHIP: UPPER LITTLE RIVER	COUNTY: HARNETT	DATE: 5-3-2021	SURVEYED BY: DH/CR
STATE: NORTH CAROLINA	PID: 130529 0019	SCALE: 1" = 100'	DRAWN BY: PAN
ZONE: RA-30	PIN: 0529-88-5353.000	CHECKED & CLOSURE BY: TLS	

FIELD BOOK
LHULR1252.cgr
DRAWING FILE NO.
LHULR-1252 D

50 0 100
Horizontal Scale

RECORDED IN HARNETT COUNTY, MAP NUMBER 2023 - 62



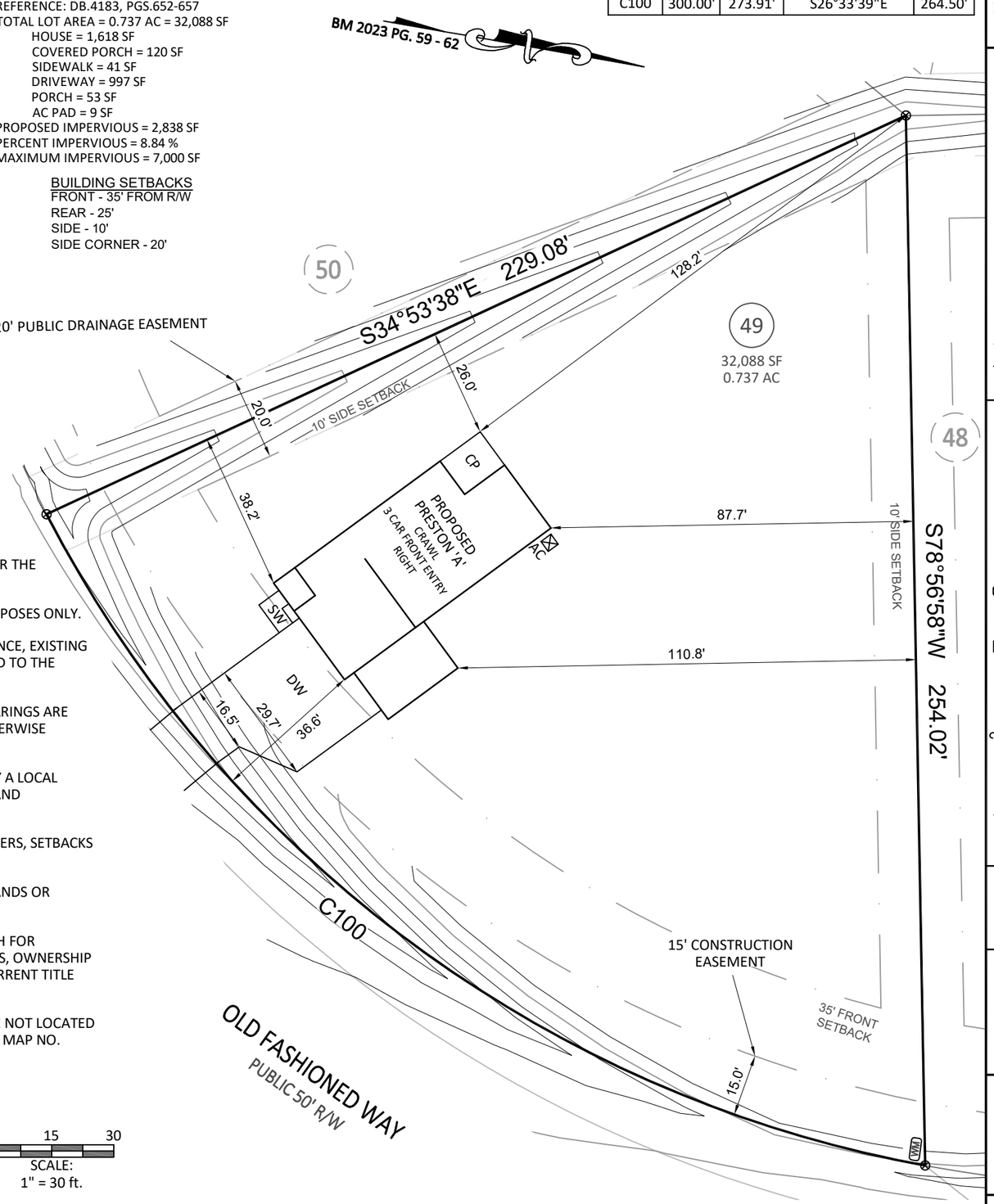
INSET SCALE: 1"=20'

LOT INFORMATION:

PIN: 0529-97-0717.000
REFERENCE: DB.4183, PGS.652-657
TOTAL LOT AREA = 0.737 AC = 32,088 SF
HOUSE = 1,618 SF
COVERED PORCH = 120 SF
SIDEWALK = 41 SF
DRIVEWAY = 997 SF
PORCH = 53 SF
AC PAD = 9 SF
PROPOSED IMPERVIOUS = 2,838 SF
PERCENT IMPERVIOUS = 8.84 %
MAXIMUM IMPERVIOUS = 7,000 SF

BUILDING SETBACKS
FRONT - 35' FROM R/W
REAR - 25'
SIDE - 10'
SIDE CORNER - 20'

CURVE TABLE				
CURVE	RADIUS	LENGTH	CHORD DIRECTION	CHORD
C100	300.00'	273.91'	S26°33'39"E	264.50'

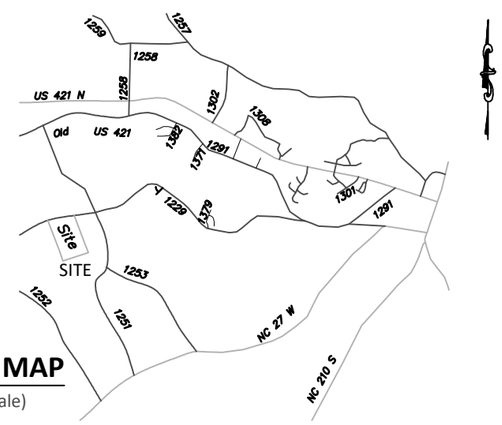


NOTES:

1. THIS SURVEY WAS PREPARED BY BATEMAN CIVIL SURVEY CO., UNDER THE SUPERVISION OF STEVEN P. CARSON, PLS.
2. THIS PLAN HAS BEEN PREPARED FOR LAYOUT AND PERMITTING PURPOSES ONLY.
3. PROPERTY LINES SHOWN WERE TAKEN FROM EXISTING FIELD EVIDENCE, EXISTING DEEDS AND PLATS OF PUBLIC RECORD, AND INFORMATION SUPPLIED TO THE SURVEYOR BY THE CLIENT
4. ALL DISTANCES ARE HORIZONTAL GROUND DISTANCES AND ALL BEARINGS ARE NORTH CAROLINA STATE PLANE COORDINATE SYSTEM UNLESS OTHERWISE SHOWN.
5. THIS MAP IS NOT FOR RECORDATION AND SHOULD BE REVIEWED BY A LOCAL GOVERNMENT AGENCY FOR COMPLIANCE WITH ANY APPLICABLE LAND DEVELOPMENT REGULATIONS
6. THE BASIS OF NORTH AND ALL EASEMENTS, RIGHTS-OF-WAYS, BUFFERS, SETBACKS AND ADJOINERS, ETC. REFERENCED IN TITLE BLOCK
7. NO INVESTIGATION INTO THE EXISTENCE OF JURISDICTIONAL WETLANDS OR RIPARIAN BUFFERS PERFORMED BY THIS FIRM.
8. SURVEYOR HAS MADE NO INVESTIGATION OR INDEPENDENT SEARCH FOR EASEMENTS OF RECORD, ENCUMBRANCES, RESTRICTIVE COVENANTS, OWNERSHIP TITLE EVIDENCE OR ANY OTHER FACTS THAT AN ACCURATE AND CURRENT TITLE SEARCH MAY DISCLOSE.
9. FEMA FLOOD HAZARD STATEMENT: LOTS SHOWN ON THIS PLAT ARE NOT LOCATED WITHIN THE FEMA FLOOD HAZARD "ZONE AE" AS SHOWN ON FEMA MAP NO. 3720064000J & 3720054800J EFFECTIVE DATE 10/3/2006.
10. ZONING: RA-30
11. PROPERTY OWNER: DAVIDSON HOMES
1903 NORTH HARRISON AVENUE
CARY, NC 27513

0 15 30
SCALE:
1" = 30 ft.

Bateman Civil Survey Company
Engineers • Surveyors • Planners
2524 Reliance Avenue, Apex, NC 27539 Ph: 919.577.1080 Fax: 919.577.1081
www.batemancivilsurvey.com info@batemancivilsurvey.com
NCBELS Firm No. C-2378



VICINITY MAP
(Not to Scale)

LEGEND
PO = PORCH
SP = SCREENED PORCH/PATIO
CP = COVERED PORCH/PATIO
WD = WOOD DECK
SW = SIDEWALK
DW = CONC DRIVEWAY
P = CONC PATIO
⊗= COMPUTED POINT
X= MAG NAIL FOUND
O= IRON PIPE FOUND
◉= IRON PIPE SET
●= DRILL HOLE FOUND
WM = WATER METER
CO = CLEAN OUT
AC = AIR CONDITIONER
Ⓢ= SEWER MANHOLE
EB = ELECTRIC BOX
© = CABLE BOX
T = TELEPHONE PEDESTAL
CB = CATCH BASIN
IC = IRRIGATION CONTROLLER
= LIGHT POLE
= UTILITY POLE
= FIRE HYDRANT
DI = DRAIN INLET
WV = WATER VALVE
= STREET SIGN
YI = YARD INLET
G = GAS METER
E = ELECTRIC METER

I, STEVEN P. CARSON, CERTIFY THAT THIS PLAT WAS DRAWN UNDER MY DIRECT SUPERVISION FROM A SURVEY MADE UNDER MY SUPERVISION (PLAT BOOK REFERENCED IN TITLE BLOCK); THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED AS DRAWN FROM INFORMATION LISTED UNDER REFERENCES; THAT THE RATIO OF PRECISION AS CALCULATED IS 1:10,000+; AND THAT THIS MAP MEETS THE REQUIREMENTS OF THE STANDARD OF PRACTICE FOR LAND SURVEYING IN NORTH CAROLINA. L-4752
DATED:

PRELIMINARY

This map is of an existing parcel of land and is only intended for the parties and purposes shown. This map not for recordation. No title report provided.

BUILDER TO VERIFY HOUSE LOCATION
DIMENSIONS AND REVIEW TOTAL
IMPERVIOUS NOTED ON THIS PLOT PLAN

PRELIMINARY PLOT PLAN
FOR
DAVIDSON HOMES

WELLERS KNOLL - LOT 49
OLD FASHIONED WAY, LILLINGTON, NC
LITTLE RIVER TOWNSHIP, HARNETT COUNTY

DATE: 8/24/23 DRAWN BY: AMG CHECKED BY: SPC

REFERENCE: BM 2023 PG. 59-62 BCS# 230051 SCALE: 1" = 30'

3-Bedroom
40' x 70' House Box
LTAR: 0.3 gpd/ft^2
Initial: Horizontal Panel Block utilizing lines 4-6 (210')
Repair: Horizontal Panel Block utilizing lines 1-3 (210')

48

SITE BOUNDARY

Repair septic drainfield

1: 70'
2: 70'
3: 70'
4: 70'
5: 70'
6: 70'

49

Initial septic drainfield

50

GRAPHIC SCALE
0 30 60
1 inch = 30 ft.

NAD 83

NOTES:
-Septic system designs based on Harnett County GIS topographic data and septic soil suitability observations by Mitchell Environmental staff. Field staking of septic systems will likely result in septic system designs that are somewhat different than the designs illustrated hereon.
-Does not guarantee issuance of septic system permits, listed bedroom count, or septic system type.
-Not approved by Harnett County or other regulatory body.
-Suitable for preliminary planning purposes only.

SHEET NUMBER 6 of 7

Wellers Knoll
Lot 49
Overall Septic

REVISION NO.	DATE
Original Submittal	February 20, 2023
Revision 1	-----
Revision 2	-----
Revision 3	-----
Master Set	-----

PREPARED FOR : Davidson Homes
336 James Record Road
Huntsville, AL 35824

DATE : February 20, 2023

ENGINEER AND SOIL SCIENTIST CONTACT:
SCOTT MITCHELL, PE, LSS

DRAWN BY:
ADAM AYCOCK, EI

MITCHELL ENVIRONMENTAL, PA
C-2911
1501 LAKESTONE VILLAGE LANE
SUITE 205
FUQUAY VARINA, NC 27526

Wellers Knoll - Lot 49				
Location	**Fixture**	**Qty**	**Manufacture**	**Model**
Kitchen	Sink Faucet	1	Moen	Integra 67315
Guest Bath	Sink Faucet	1	Moen	Chateau L4625
Guest Bath	Shower	1	Moen	Chateau TL182
Guest Bath	Toilet	1	Gerber	Maxwell MX28-990 Tank
Bath 2	Sink Faucet	2	Moen	Chateau L4625
Bath 2	Tub/Shower	1	Moen	Chateau TL183
Bath 2	Toilet	1	Gerber	Maxwell MX28-990 Tank
Owner's Bath	Sink Faucet	2	Moen	Chateau L4625
Owner's Bath	Shower	1	Moen	Chateau TL182
Owner's Bath	Toilet	1	Gerber	Maxwell MX28-990 Tank

PRESTON

ELEVATION A

3-CAR
FRONT LOAD
OPTION

WELLERS KNOLL LOT 49

INCLUDED OPTIONS:
1st FLOOR
GUEST SUITE W/ FULL BATH
GUEST SHOWER ILO TUB
BOX OAK STAIRS
OPEN STAIR RAIL
THIRD CAR GARAGE
GARAGE SERVICE DOOR
2nd FLOOR
TRAY @ OWNERS
SECOND SINK @ BATH 2

SQUARE FOOTAGE		
	ELEVATION 'A'	
	UNHEATED	HEATED
FIRST FLOOR	0	1189
SECOND FLOOR	0	1656
REAR COVERED PORCH	120	0
FRONT PORCH	53	0
2- CAR GARAGE	436	0
SUBTOTALS	609	2845
TOTAL UNDER ROOF	3454	

OPTIONS		
	UNHEATED S.F.	HEATED S.F.
1 CAR GARAGE	+295	0

DAVIDSON HOMES

REV. #	DESCRIPTION	DATE
3	REDUCED OVERHANG TO 6"	05/15/2023
4	---	---
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---

2870 - THE PRESTON - RH --- Cover Sheet 'A'

DRAWN BY:
South Designs

ISSUE DATE:
06/06/2022

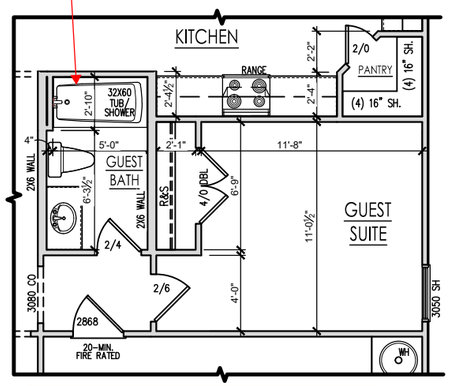
CURRENT REVISION DATE:
05/15/2023

SCALE:
1/8" = 1'-0"

SHEET
0.0a

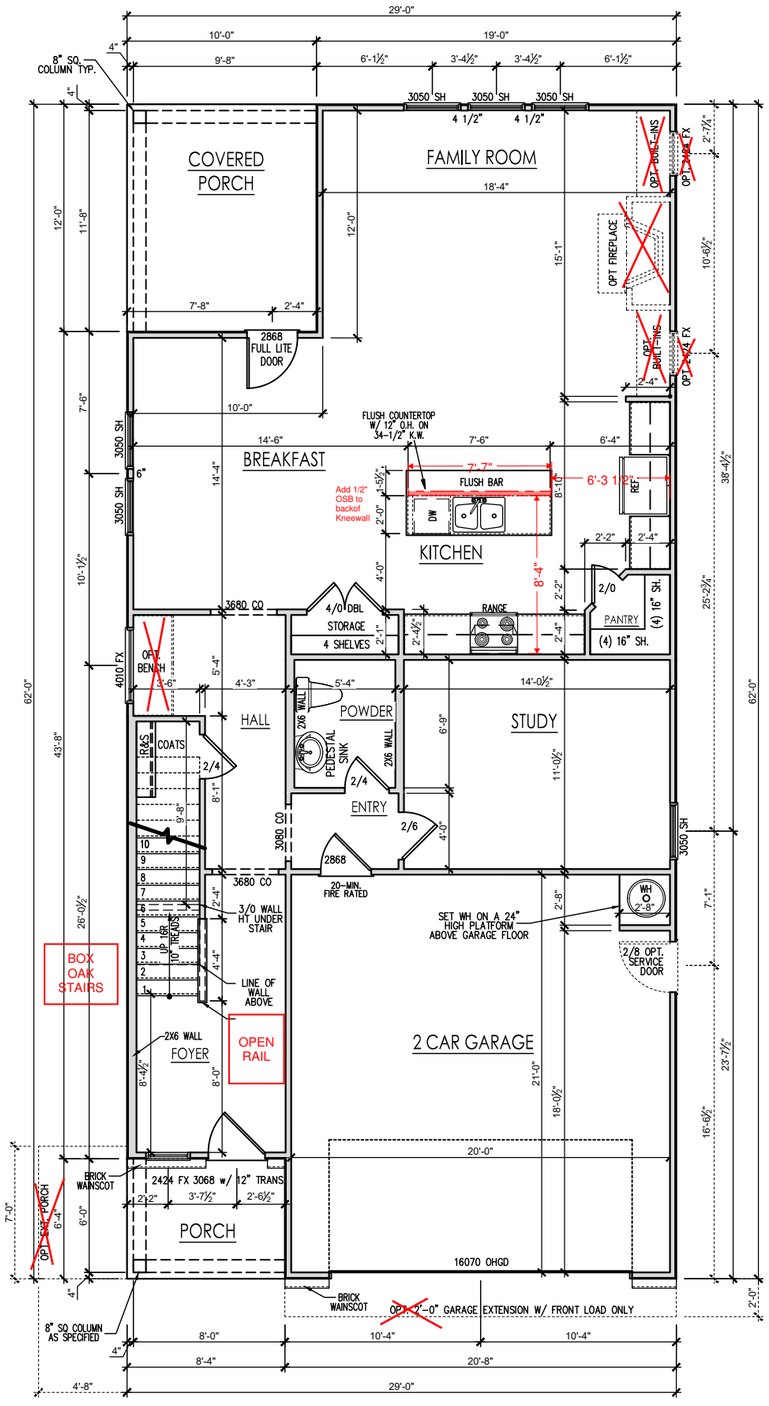
WELLERS KNOLL LOT 49

FG SHOWER PAN
W/CEILING HEIGHT WALL TILE
ilo TUB/SHOWER



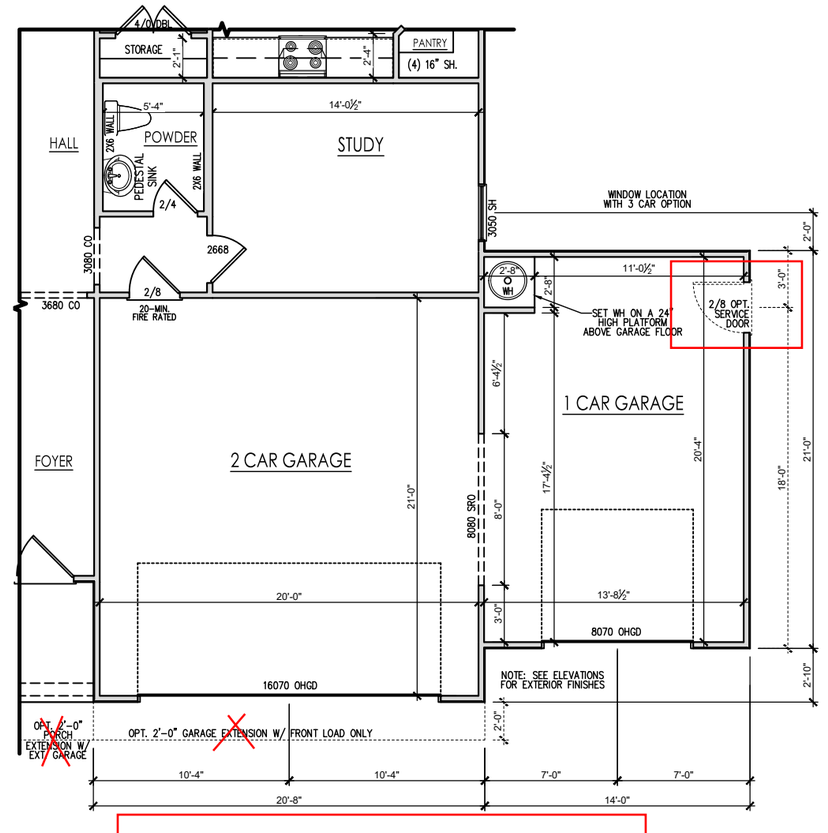
OPT. GUEST SUITE

SCALE: 1/8"=1'-0" ON 11x17, 1/4"=1'-0" ON 22x34



FIRST FLOOR PLAN 'A'

SCALE: 1/8"=1'-0" ON 11x17, 1/4"=1'-0" ON 22x34



3 CAR FRONT LOAD FLOOR PLAN

SCALE: 1/8"=1'-0" ON 11x17, 1/4"=1'-0" ON 22x34

General Floor Plan Notes

General Floor Plan Notes shall apply unless noted otherwise on plan.

1. Wall Heights: Typically 9'-1 1/2" at first floor and second floor, and 8'-1 1/2" at attics U.N.O. All walls are constructed using a double top plate. Splices at Double Top Plate do not need to occur at Vertical Studs but must be at least 24" apart from Joint in other Top Plate layer. Special wall heights are noted on plans where they occur.
2. Wall Thickness is typically 4" at exterior walls, 3 1/2" at interior. 2x6 frame shall be used at walls that back up to plumbing fixtures. Walls greater than 10' high shall be framed with 2x6 framing or greater and will be noted as a special condition where it occurs on plan.
3. Typical header height shall be 8'-0" AFF at First Floor, and 7'-0" AFF at Second Floor U.N.O.
4. Jacks: Openings up to 3'-4" wide shall have (1) 2x4 jack stud SPF on each side. Openings greater than 3'-4" wide shall have (2) 2x4 jack studs SPF on each side.
5. Soffits, Coffered Ceilings, Trey Ceilings and other significant ceiling plan elements are shown on the floor plans and are denoted as single dashed lines. Unless specifically call out as included, Kitchens do not include soffits over wall cabinetry.
6. Door & Window Frames, where occurring near corners, shall be a minimum of 4 1/2" from corner. Except for walk-in closets with doors near a corner, doors at closets shall be centered on closet.
7. Windows: Shall have at least (1) window in each sleeping room, that meets egress. Shall be provided with tempered glass at hazardous glazing areas. False windows shall be installed with obscure glazing.
8. Closets for clothing or coat storage shall be equipped with 1 rod/shelf (unless otherwise noted). Closets for linen shall have 5 open equal shelves. Closets for pantries shall have 5 equal wood shelves, painted.
9. Stair treads shall be a min of 9" deep, risers shall be a maximum of 8 1/4", unless noted otherwise, per the current North Carolina Residential Code
10. Handrails and Guards at stairs shall be 34" above the finished surface of the ramp surface of the stair. Handrails at landings and overlooks of multilevel spaces shall be 36" above finished floor. Guards (pickets or balisters) shall be spaced with no more than 4" between guards.
11. Attic Access shall be provided at all attic area with a height greater than 30". Minimum clear attic access shall be 20" x 30". Pull down stairs and access doors in knee walls meeting minimum criteria are also acceptable.
12. Garage Door to Living Space shall be 2'-8" x 6'-8" minimum size and shall be 20 minute fire rated and weather sealed.
13. Garage Walls, as a minimum, shall be separated from living space by installing 1/2" gypsum board on the garage side of the wall. With habitable space above, the inside of all garage walls require 1/2" GWB supporting 5/8" type X GWB on ceiling.

DAVIDSON HOMES

REV #	DESCRIPTION	DATE
3	REDUCED OVERHANG TO 6"	05/15/2023
4	---	---
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---

2870 - THE PRESTON - RH

First Floor Plan 'A'

DRAWN BY: South Designs

ISSUE DATE: 06/06/2022

CURRENT REVISION DATE: 05/15/2023

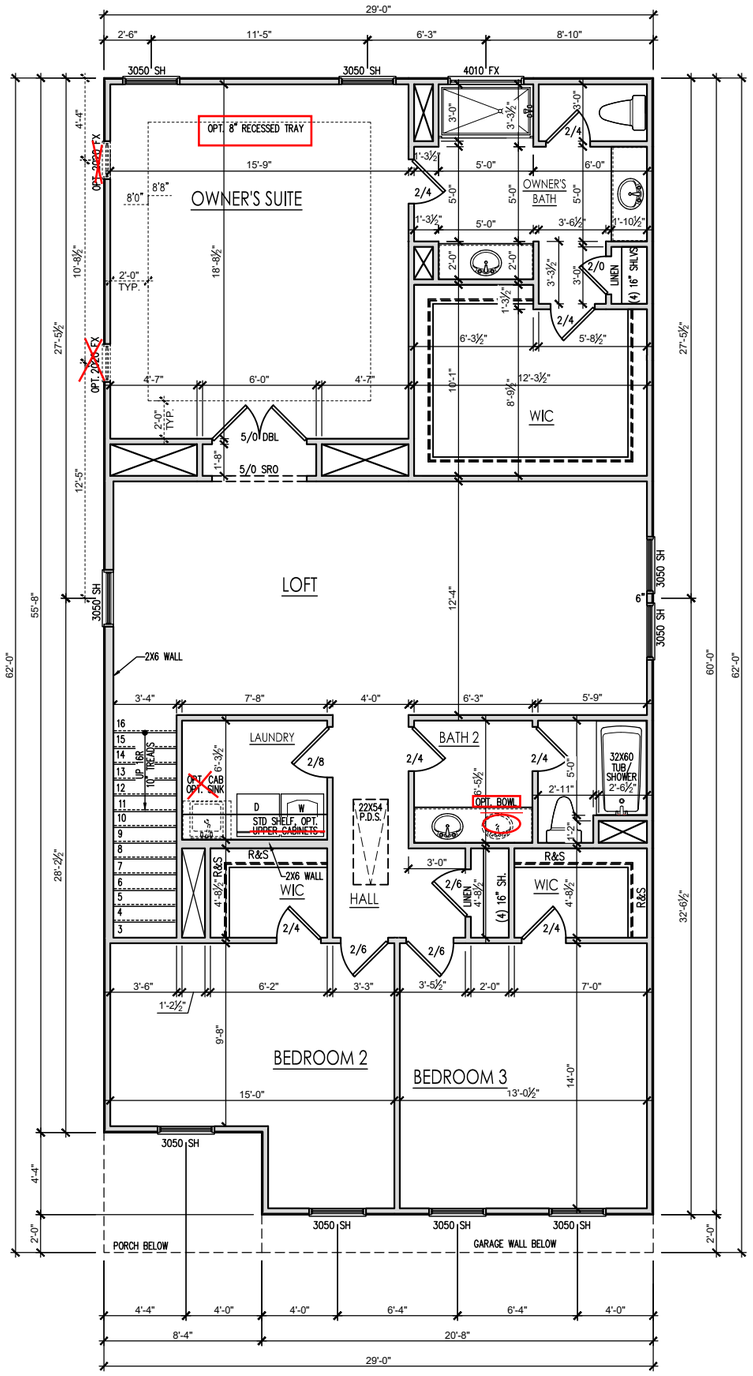
SCALE: 1/8" = 1'-0"

SHEET 2.1a

General Floor Plan Notes

General Floor Plan Notes shall apply unless noted otherwise on plan.

1. Wall Heights: Typically 9'-1 1/2" at first floor and second floor, and 8'-1 1/2" at attics U.N.O. All walls are constructed using a double top plate. Splices at Double Top Plate do not need to occur at Vertical Studs but must be at least 24" apart from Joint in other Top Plate layer. Special wall heights are noted on plans where they occur.
2. Wall Thickness is typically 4" at exterior walls, 3 1/2" at interior. 2x6 frame shall be used at walls that back up to plumbing fixtures. Walls greater than 10' high shall be framed with 2x6 framing or greater and will be noted as a special condition where it occurs on plan.
3. Typical header height shall be 8'-0" AFF at First Floor, and 7'-0" AFF at Second Floor U.N.O.
4. Jacks: Openings up to 3'-4" wide shall have (1) 2x4 jack stud SPF on each side. Openings greater than 3'-4" wide shall have (2) 2x4 jack studs SPF on each side.
5. Soffits, Coffered Ceilings, Trey Ceilings and other significant ceiling plan elements are shown on the floor plans and are denoted as single dashed lines. Unless specifically call out as included, Kitchens do not include soffits over wall cabinetry.
6. Door & Window Frames, where occurring near corners, shall be a minimum of 4 1/2" from corner. Except for walk-in closets with doors near a corner, doors at closets shall be centered on closet.
7. Windows: Shall have at least (1) window in each sleeping room, that meets egress. Shall be provided with tempered glass at hazardous glazing areas. False windows shall be installed with obscure glazing.
8. Closets for clothing or coat storage shall be equipped with 1 rod/shelf (unless otherwise noted). Closets for linen shall have 5 open equal shelves. Closets for pantries shall have 5 equal wood shelves, painted.
9. Stair treads shall be a min of 9" deep, risers shall be a maximum of 8 1/4", unless noted otherwise, per the current North Carolina Residential Code
10. Handrails and Guards at stairs shall be 34" above the finished surface of the ramp surface of the stair. Handrails at landings and overlooks of multilevel spaces shall be 36" above finished floor. Guards (pickets or balisters) shall be spaced with no more than 4" between guards.
11. Attic Access shall be provided at all attic area with a height greater than 30". Minimum clear attic access shall be 20" x 30". Pull down stairs and access doors in knee walls meeting minimum criteria are also acceptable.
12. Garage Door to Living Space shall be 2'-8" x 6'-8" minimum size and shall be 20 minute fire rated and weather sealed.
13. Garage Walls, as a minimum, shall be separated from living space by installing 1/2" gypsum board on the garage side of the wall. With habitable space above, the inside of all garage walls require 1/2" GWB supporting 5/8" type X GWB on ceiling.



SECOND FLOOR PLAN 'A'

SCALE: 1/8"=1'-0" ON 11x17, 1/4"=1'-0" ON 22x34

WELLERS KNOLL LOT 49

DAVIDSON HOMES

REV #	DESCRIPTION	DATE
3	REDUCED OVERHANG TO 6"	05/15/2023
4	---	---
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---

2870 - THE PRESTON - RH

Second Floor Plan 'A'

DRAWN BY: South Designs

ISSUE DATE: 06/06/2022

CURRENT REVISION DATE: 05/15/2023

SCALE: 1/8" = 1'-0"

SHEET 2.2a

WELLERS KNOLL LOT 49

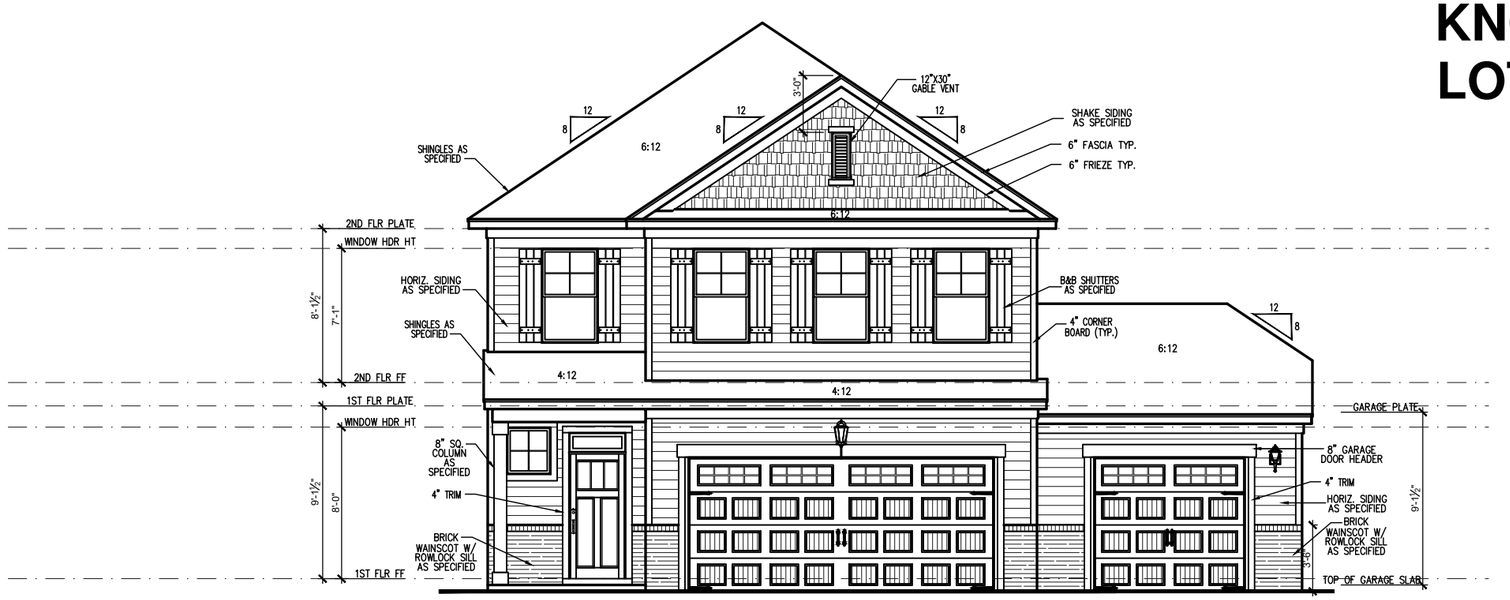
General Elevation Notes

General Elevation Notes shall apply unless noted otherwise on plan.

1. Roof shall be finished with architectural composition shingles with slopes as noted on plan.
2. Ridge Vent shall be provided and installed on all ridges greater than 6' in length per manufacturer's specifications.
3. Soffit Vent shall be continuous soffit vent
4. House Wrap, "tyvek" or approved equal shall be installed over entire exterior wall per manufacturer's specifications and recommendations.
5. Flashing shall be provided above all door and window openings, above finish wall material changes and at wall surfaces where lower roof areas abut vertical wall surfaces.
6. Porch Railings shall be provided at all porch walking surfaces greater than 30" above adjacent finished grade. It shall be 36" high with guards spaced no more than 4" apart. Consult community specifications for material.
7. Finish Wall Material shall be as noted on elevation drawings.
8. Brick Veneer, if included on elevation shall be tied to wall surface with galvanized corrugated metal ties at a rate of 24" oc horizontally and 16" oc vertically so that no more than 2.67sf of brick is supported by (1) tie. Space between face of wall and back face of brick shall be limited to a maximum of 1". Flashing shall be provided behind brick above all wall openings and at base of brick wall. Flashing shall be a minimum of 6-mil poly or other corrosion resistant material and shall be installed so that it laps under the house wrap material a minimum of 2". Weepholes shall be provided at a rate of 48" oc and shall not be less than 3/16" in diameter and shall be located immediately above flashing.
9. Brick Veneer Support Lintels shall be provided if brick veneer is included on elevation. Lintels shall be provided as listed in the following schedule and shall have a minimum bearing length of 6". Masonry Lintels shall be provided so that deflection is limited to L/600.

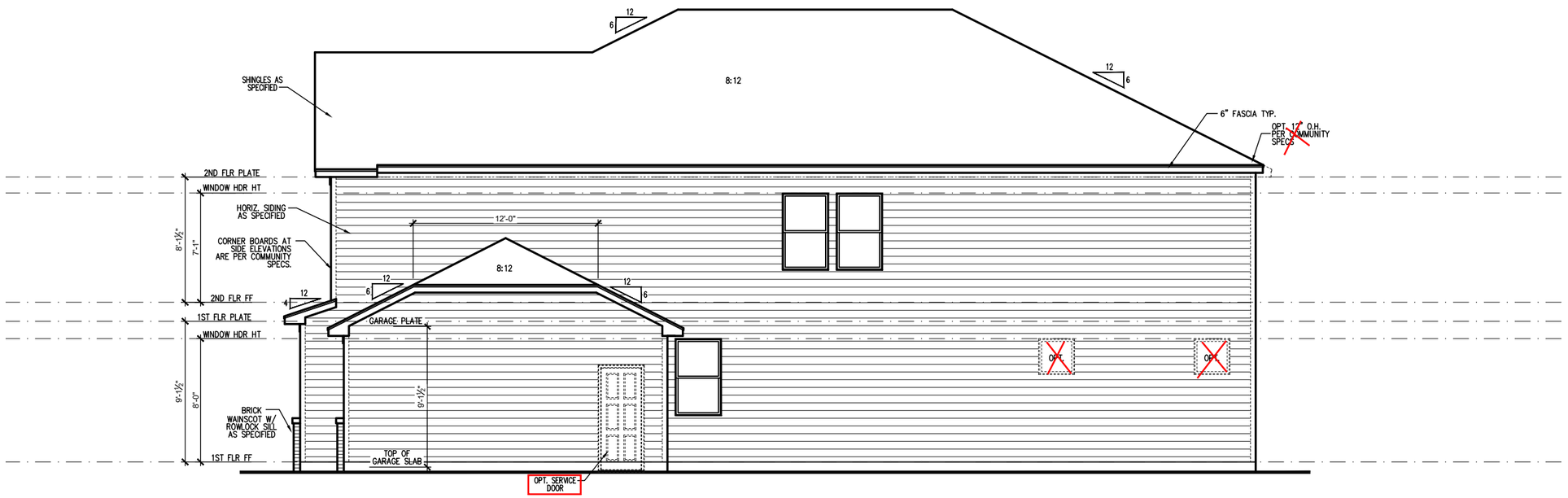
Masonry Opening Lintel Schedule

Opening Size	Angle
up to 4'-0"	3-1/2" x 3-1/2" x 5/16"
4'-1" to 5'-6"	4" x 3-1/2" x 5/16" LLV
5'-7" to 6'-6"	5" x 3-1/2" x 5/16" LLV
6'-7" to 8'-4"	6" x 3-1/2" x 5/16" LLV
8'-5" to 16'-4"	7" x 4" x 3/8" LLV



FRONT ELEVATION 'A' - 3 CAR FRONT LOAD

SCALE: 1/8"=1'-0" ON 11x17, 1/4"=1'-0" ON 22x34



RIGHT ELEVATION 'A' - 3 CAR FRONT LOAD

SCALE: 1/8"=1'-0" ON 11x17, 1/4"=1'-0" ON 22x34

DAVIDSON HOMES

REV. #	DESCRIPTION	DATE
3	REDUCED OVERHANG TO 6"	05/15/2023
4	---	---
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---

2870 - THE PRESTON - RH

Front Load 3-Car Garage Elevations 'A'

DRAWN BY: South Designs

ISSUE DATE: 06/06/2022

CURRENT REVISION DATE: 05/15/2023

SCALE: 1/8" = 1'-0"

SHEET 2.8a

General Elevation Notes

General Elevation Notes shall apply unless noted otherwise on plan.

1. Roof shall be finished with architectural composition shingles with slopes as noted on plan.
2. Ridge Vent shall be provided and installed on all ridges greater than 6' in length per manufacturer's specifications.
3. Soffit Vent shall be continuous soffit vent
4. House Wrap, "tyvek" or approved equal shall be installed over entire exterior wall per manufacturer's specifications and recommendations.
5. Flashing shall be provided above all door and window openings, above finish wall material changes and at wall surfaces where lower roof areas abut vertical wall surfaces.
6. Porch Railings shall be provided at all porch walking surfaces greater than 30" above adjacent finished grade. It shall be 36" high with guards spaced no more than 4" apart. Consult community specifications for material.
7. Finish Wall Material shall be as noted on elevation drawings.
8. Brick Veneer, if included on elevation shall be tied to wall surface with galvanized corrugated metal ties at a rate of 24" oc horizontally and 16" oc vertically so that no more than 2.67sf of brick is supported by (1) tie. Space between face of wall and back face of brick shall be limited to a maximum of 1". Flashing shall be provided behind brick above all wall openings and at base of brick wall. Flashing shall be a minimum of 6-mil poly or other corrosion resistant material and shall be installed so that it laps under the house wrap material a minimum of 2". Weepholes shall be provided at a rate of 48" oc and shall not be less than 3/16" in diameter and shall be located immediately above flashing.
9. Brick Veneer Support Lintels shall be provided if brick veneer is included on elevation. Lintels shall be provided as listed in the following schedule and shall have a minimum bearing length of 6". Masonry Lintels shall be provided so that deflection is limited to L/600.

Masonry Opening Lintel Schedule

Opening Size	Angle
up to 4'-0"	3-1/2" x 3-1/2" x 5/16"
4'-1" to 5'-6"	4" x 3-1/2" x 5/16" LLV
5'-7" to 6'-6"	5" x 3-1/2" x 5/16" LLV
6'-7" to 8'-4"	6" x 3-1/2" x 5/16" LLV
8'-5" to 16'-4"	7" x 4" x 3/8" LLV

WELLERS KNOLL LOT 49

LEFT SIDE ELEVATION 'A'

SCALE: 1/4" = 1'-0" ON 22x34, 1/8" = 1'-0" ON 11x17

DAVIDSON HOMES

REV. #	DESCRIPTION	DATE
3	REDUCED OVERHANG TO 6"	05/15/2023
4	---	---
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---

2870 - THE PRESTON - RH

Elevations 'A'

DRAWN BY: South Designs

ISSUE DATE: 06/06/2022

CURRENT REVISION DATE: 05/15/2023

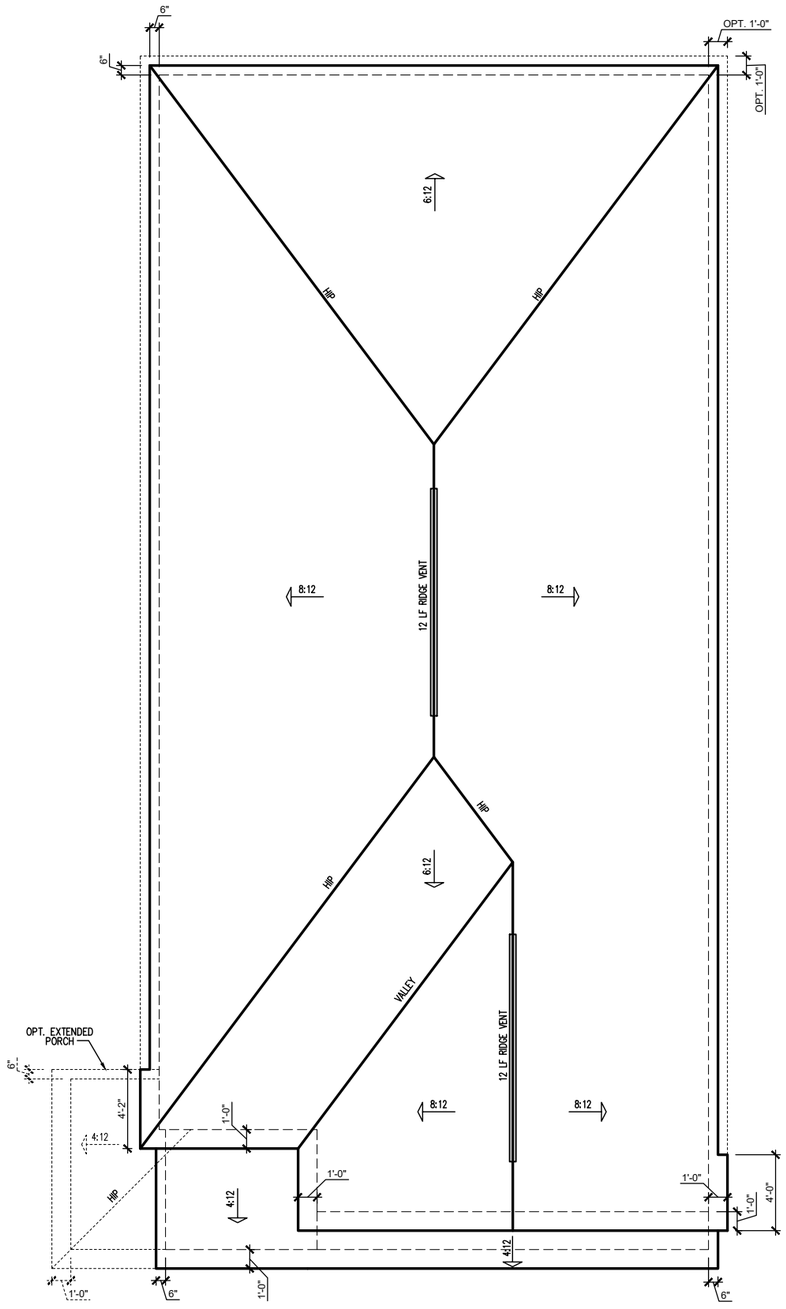
SCALE: 1/8" = 1'-0"

SHEET 3.2a

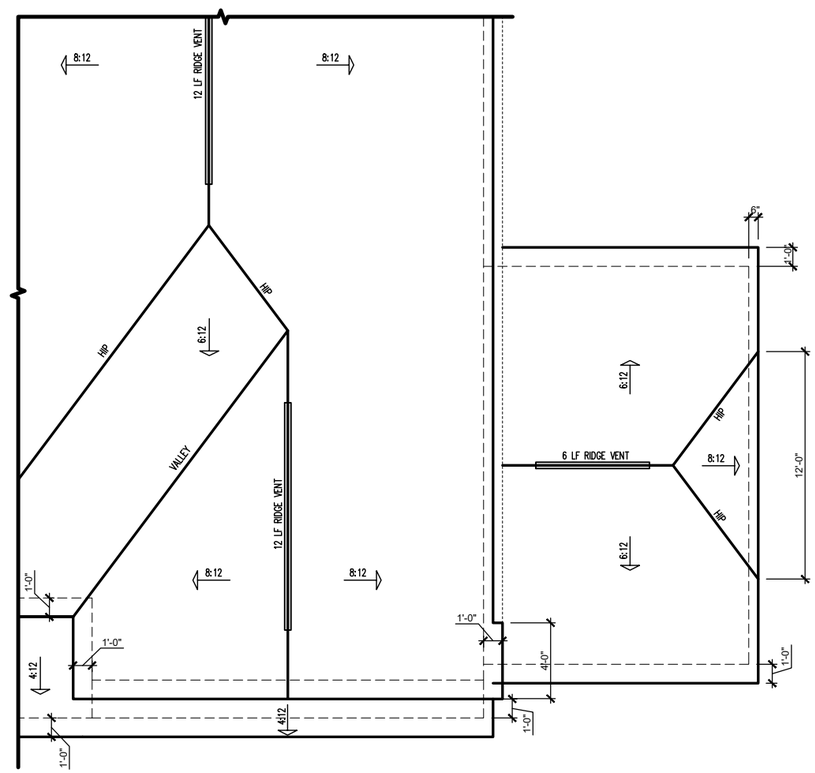
WELLERS KNOLL LOT 49

ATTIC VENT SCHEDULE									
ELEVATION 'A'									
MAIN HOUSE		SQ FTG	1707	AT / NEAR RIDGE			AT / NEAR EAVE		
VENT TYPE	SQ. FT. REQUIRED RANGE		SQ. FT. SUPPLIED	PERCENT OF TOTAL SUPPLIED	POT LARGE (SQ. FT. EACH)	POT SMALL (SQ. FT. EACH)	RIDGE VENT (SQ. FT. PER LF)	EAVE VENT (SQ. IN. EACH)	CONT. VENT (SQ. IN. PER LF)
					0.4236	0.2778	0.125	0.1944	0.0625
RIDGE VENT	2.28	2.85	3.00	50.00	0	0	24.00		
SOFFIT VENTS	3.41	2.85	3.00	50.00				0	48.00
TOTAL (MIN)	5.69	5.69	6.00	100.00	POT VENTS MAY BE REQUIRED IF THERE IS INSUFFICIENT RIDGE AVAILABLE				

* SCHEDULE HAS BEEN CALCULATED ASSUMING EAVE VENTILATION AT 50-60% OF TOTAL AND RIDGE AT 40-50% OF TOTAL REQUIRED VENTILATION



ELEVATION 'A' ROOF PLAN
SCALE: 1/4" = 1'-0" ON 22x34, 1/8" = 1'-0" ON 11x17



3 CAR FRONT LOAD GARAGE ROOF PLAN 'A'
SCALE: 1/8"=1'-0" ON 11x17, 1/4"=1'-0" ON 22x34

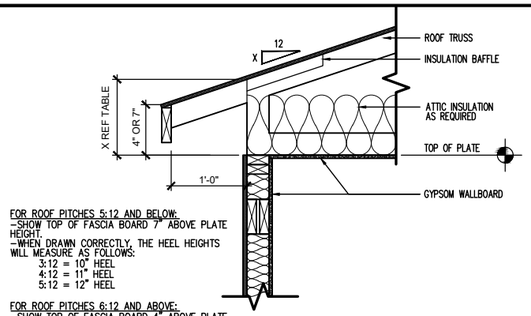
DAVIDSON HOMES

REV. #	DESCRIPTION	DATE
3	REDUCED OVERHANG TO 6"	05/15/2023
4	---	---
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---

2870 - THE PRESTON - RH

Roof Plan 'A'

DRAWN BY: South Designs
ISSUE DATE: 06/06/2022
CURRENT REVISION DATE: 05/15/2023
SCALE: 1/8" = 1'-0"
SHEET 3.5a



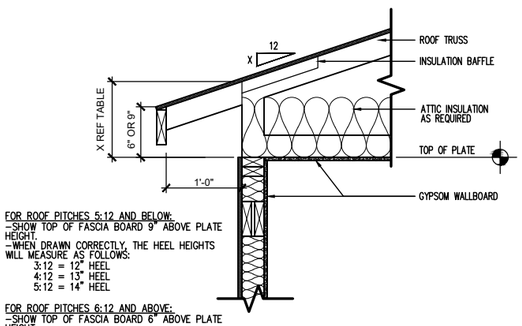
FOR ROOF PITCHES 5:12 AND BELOW:
-SHOW TOP OF FASCIA BOARD 7" ABOVE PLATE HEIGHT.
-WHEN DRAWN CORRECTLY, THE HEEL HEIGHTS WILL MEASURE AS FOLLOWS:
3:12 = 10" HEEL
4:12 = 11" HEEL
5:12 = 12" HEEL

FOR ROOF PITCHES 6:12 AND ABOVE:
-SHOW TOP OF FASCIA BOARD 4" ABOVE PLATE HEIGHT.
-WHEN DRAWN CORRECTLY, THE HEEL HEIGHTS WILL MEASURE AS FOLLOWS:
6:12 = 10" HEEL
7:12 = 11" HEEL
8:12 = 12" HEEL
9:12 = 13" HEEL
10:12 = 14" HEEL

IMPORTANT REMINDER: THE LOWEST PITCH ROOF ALWAYS MANDATES THE CONDITION. FOR EXAMPLE , A ROOF WITH A 4:12 PITCH AND A 6:12 PITCH, WOULD FOLLOW THE 7" ABOVE PLATE HEIGHT RULE. THE HEEL FOR THE 6:12 ROOF IN THIS CONDITION WILL DIFFER FROM WHAT IS LISTED HERE.

ENERGY HEEL DETAIL: CZ 2 & 3

SCALE: 1" = 1'-0" ON 22x34, 1/2" = 1'-0" ON 11x17



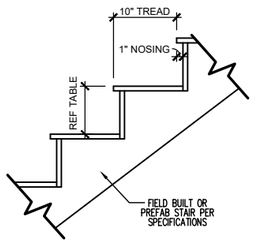
FOR ROOF PITCHES 5:12 AND BELOW:
-SHOW TOP OF FASCIA BOARD 9" ABOVE PLATE HEIGHT.
-WHEN DRAWN CORRECTLY, THE HEEL HEIGHTS WILL MEASURE AS FOLLOWS:
3:12 = 12" HEEL
4:12 = 13" HEEL
5:12 = 14" HEEL

FOR ROOF PITCHES 6:12 AND ABOVE:
-SHOW TOP OF FASCIA BOARD 6" ABOVE PLATE HEIGHT.
-WHEN DRAWN CORRECTLY, THE HEEL HEIGHTS WILL MEASURE AS FOLLOWS:
6:12 = 12" HEEL
7:12 = 13" HEEL
8:12 = 14" HEEL
9:12 = 15" HEEL
10:12 = 16" HEEL

IMPORTANT REMINDER: THE LOWEST PITCH ROOF ALWAYS MANDATES THE CONDITION. FOR EXAMPLE , A ROOF WITH A 4:12 PITCH AND A 6:12 PITCH, WOULD FOLLOW THE 9" ABOVE PLATE HEIGHT RULE. THE HEEL FOR THE 6:12 ROOF IN THIS CONDITION WILL DIFFER FROM WHAT IS LISTED HERE.

ENERGY HEEL DETAIL: CZ 4 & 5

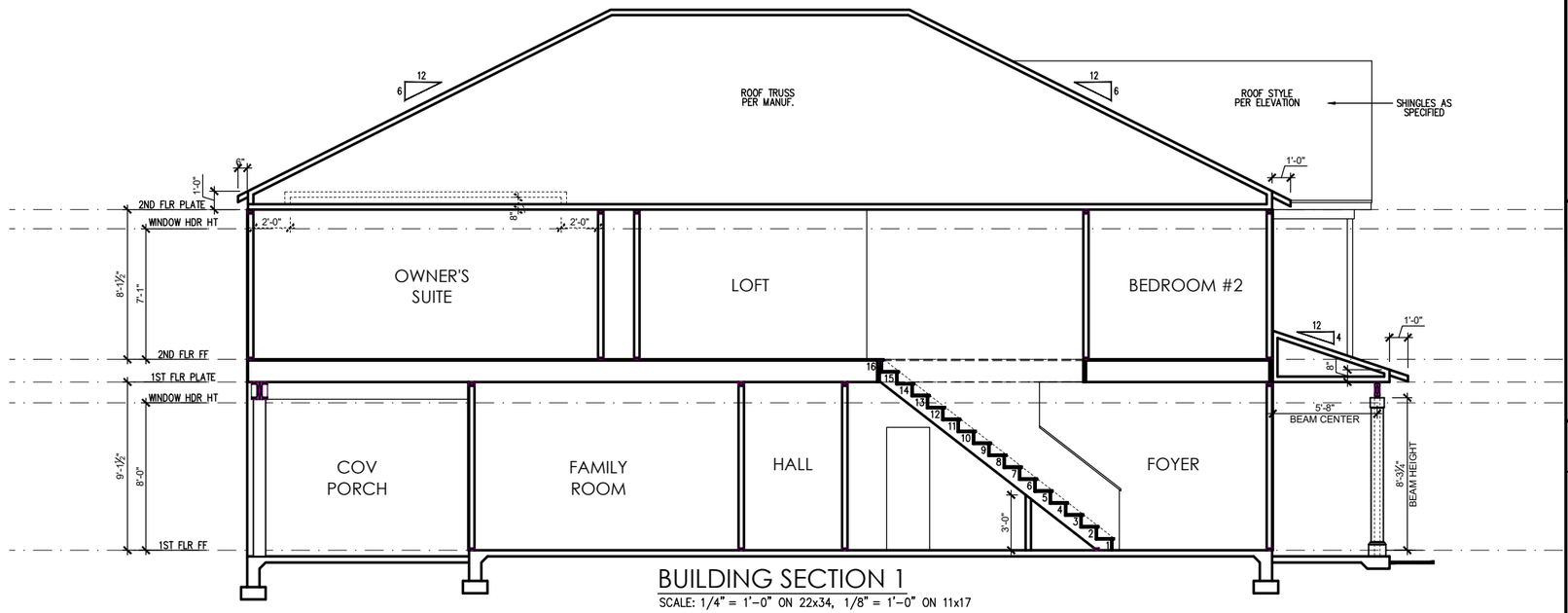
SCALE: 1" = 1'-0" ON 22x34, 1/2" = 1'-0" ON 11x17



RISER HEIGHTS PER STAIR CONFIGURATION			
PLATE HEIGHT	10" FLOOR SYSTEM	14" FLOOR SYSTEM	16" FLOOR SYSTEM
8'-1 1/2"	14 RISERS @ 7 11/16"	15 RISERS @ 7 1/2"	15 RISERS @ 7 5/8"
9'-1 1/2"	16 RISERS @ 7 1/2"	16 RISERS @ 7 3/4"	17 RISERS @ 7 7/16"
10'-1 1/2"	17 RISERS @ 7 3/4"	18 RISERS @ 7 9/16"	18 RISERS @ 7 11/16"

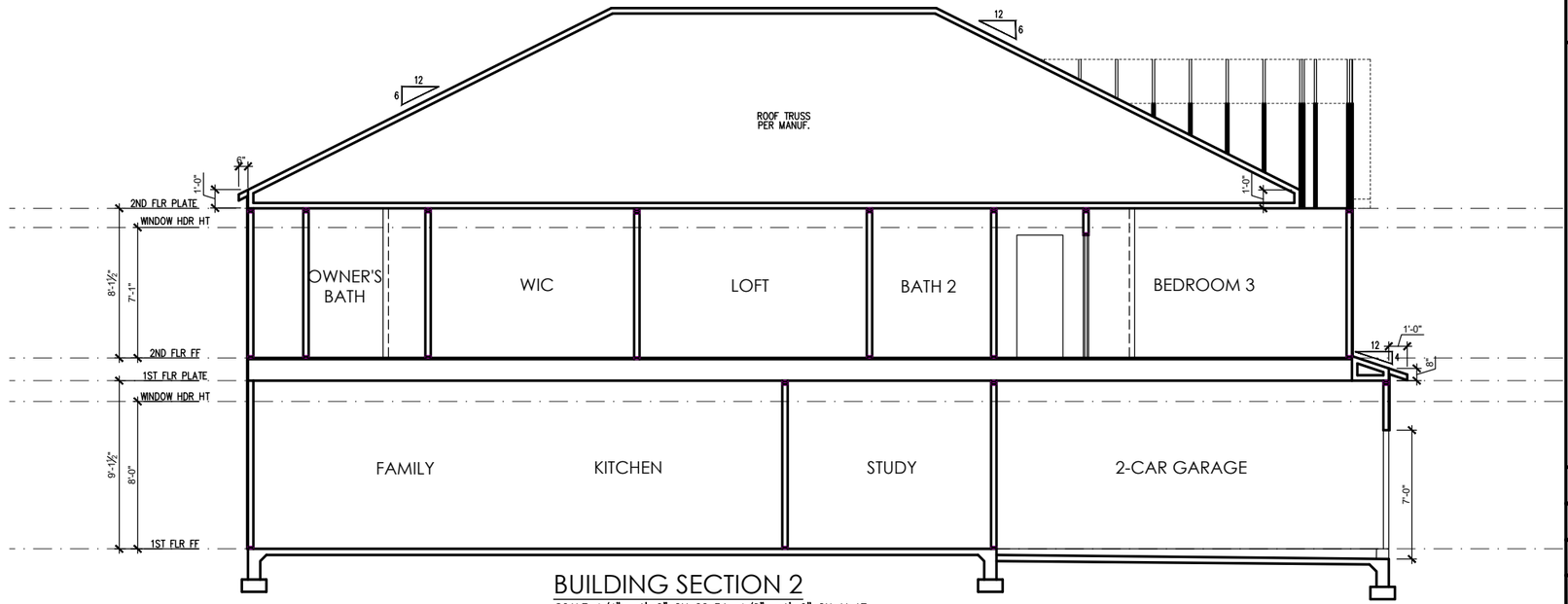
TYPICAL STAIR DETAIL

SCALE: 1" = 1'-0" ON 22x34, 1/2" = 1'-0" ON 11x17



BUILDING SECTION 1

SCALE: 1/4" = 1'-0" ON 22x34, 1/8" = 1'-0" ON 11x17



BUILDING SECTION 2

SCALE: 1/4" = 1'-0" ON 22x34, 1/8" = 1'-0" ON 11x17

DAVIDSON HOMES

REV. #	DESCRIPTION	DATE
3	REDUCED OVERHANG TO 6"	05/15/2023
4	---	---
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---

2870 - THE PRESTON - RH

Building Sections

DRAWN BY:
South Designs

ISSUE DATE:
06/06/2022

CURRENT REVISION DATE:
05/15/2023

SCALE:
1/8" = 1'-0"

SHEET
4.0

WELLERS KNOLL LOT 49

ELECTRICAL SYMBOL KEY

LIGHT FIXTURES	
	CEILING SURFACE MOUNT LIGHT
	RECESSED CAN LIGHT
WP	RECESSED CAN LIGHT WATERPROOF
	RECESSED CAN – EYEBALL
	PENDANT LIGHTING
	WALL SCONCE
	WALL MOUNT LIGHT
	FLOOD LIGHT
OUTLETS	
	DUPLEX OUTLET
GFI	GFI OUTLET
GFI–WP	WATERPROOF GFI OUTLET
	SWITCHED 1/2 HOT DUPLEX OUTLET
220v	220V OUTLET
	TELEPHONE OUTLET
	CATV (TELEVISION) OUTLET
	UNDER–COUNTER OR CONCEALED OUTLETS
	CEILING MOUNTED DUP. OUTLET
FLOOR	FLOOR MOUNTED DUP. OUTLET
SWITCHES	
$	SINGLE POLE SWITCH
$3	THREE–WAY SWITCH
$4	FOUR–WAY SWITCH
DIS	ELECTRICAL DISCONNECT
MISC FIXTURES	
	EXHAUST FAN
	JUNCTION BOX
220V	JUNCTION BOX 220V
CM SD	CARBON MONOXIDE DETECTOR OR SMOKE DETECTOR
CO.SD	CARBON MONOXIDE DETECTOR AND SMOKE DETECTOR
	ELECTRIC METER
Elec Panel	ELECTRICAL PANEL
	DOOR BELL CHIME
	DOOR BELL PUSH BUTTON
FAN PREWIRE	CEILING FAN PREWIRE
	FLUORESCENT LIGHT

General Power and Lighting:

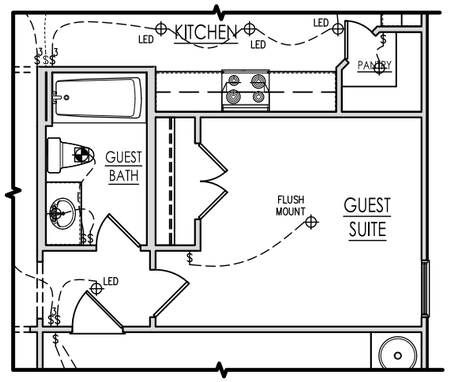
General Power and Lighting Notes shall apply unless noted otherwise on plans.

All work shall be installed per the current NC Residential Building Code, and the National Electric Code. Alarm devices shall meet NFPA 72.

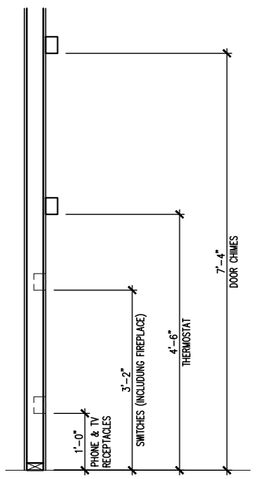
1. **Smoke Alarms - Shall be provided as a minimum of (1) per floor, including basements (if applicable), (1) in each sleep room, and (1) outside each sleeping area, within the immediate vicinity of sleeping rooms. When more than one alarm is required, the alarm devices shall be interconnected in such a manner that the activation of one alarm will activate all of the alarms. Smoke alarms shall be hard wired to permanent power and shall have batter back-ups.**

2. **Switches - For lighting, fans, etc. shall be installed at heights illustrated on this page and shall be located a minimum of 4 1/2" from door openings to allow for the proper installation of door casings. Switches, thermostats, security pads, and other similar devices shall be grouped together and installed thoughtfully for convenience of use and to avoid placement within centers of wall areas.**

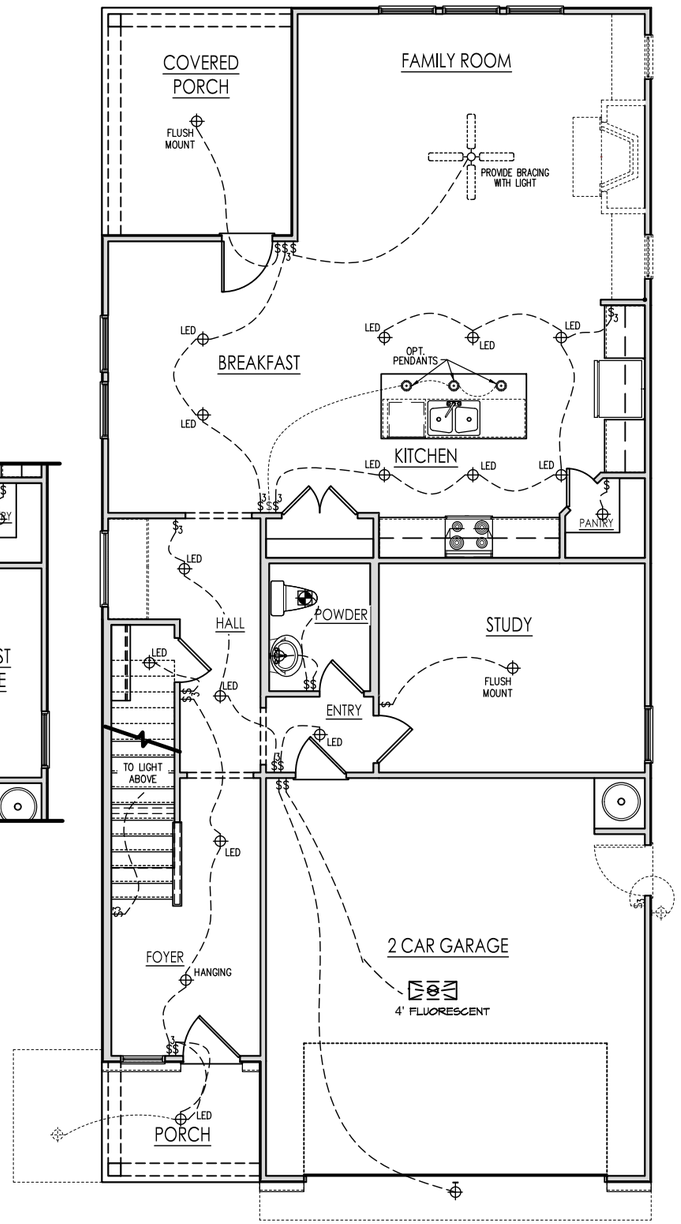
Note:
This plan is a diagram showing approximate locations of convenience outlets based on requirements found in the NC Residential Code and N.E.C. Actual positions may vary from what is shown on plan.

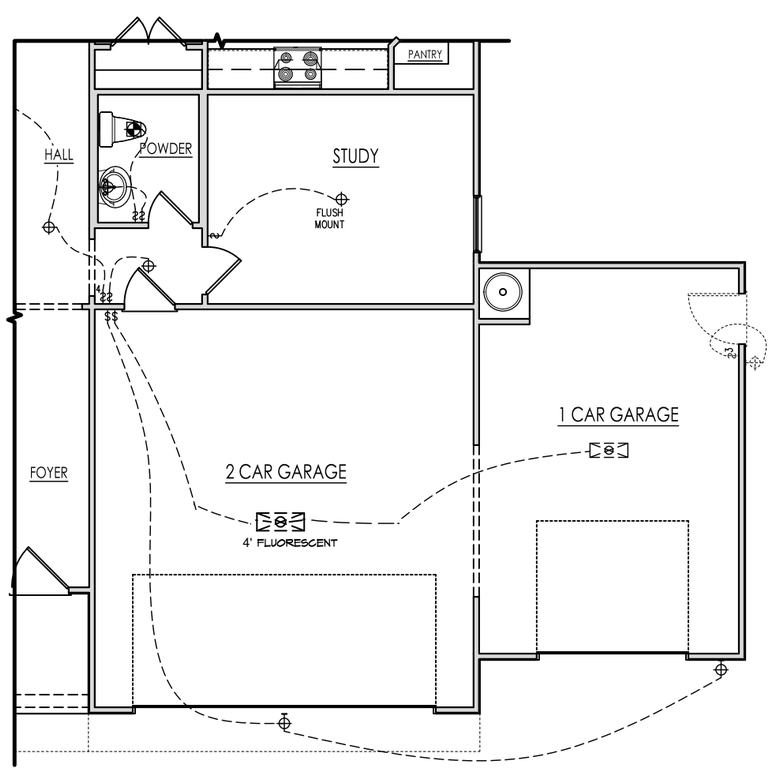


OPT. GUEST SUITE
SCALE: 1/8"=1'–0" ON 11x17, 1/4"=1'–0" ON 22x34



ELECTRICAL BOX HEIGHTS





3 CAR FRONT LOAD ELECTRICAL PLAN
SCALE: 1/8"=1'–0" ON 11x17, 1/4"=1'–0" ON 22x34

FIRST FLOOR ELECTRICAL PLAN 'A'
SCALE: 1/8"=1'–0" ON 11x17, 1/4"=1'–0" ON 22x34

DAVIDSON HOMES

REV. #	DESCRIPTION	DATE
3	REDUCED OVERHANG TO 6"	05/15/2023
4	---	---
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---

2870 - THE PRESTON - RH

First Floor Electrical 'A'

DRAWN BY: South Designs
ISSUE DATE: 06/06/2022
CURRENT REVISION DATE: 05/15/2023
SCALE: 1/8" = 1'-0"
SHEET 5.1a

WELLERS KNOLL LOT 49

ELECTRICAL SYMBOL KEY

LIGHT FIXTURES	
	CEILING SURFACE MOUNT LIGHT
	RECESSED CAN LIGHT
WP	RECESSED CAN LIGHT WATERPROOF
	RECESSED CAN – EYEBALL
	PENDANT LIGHTING
	WALL SCONCE
	WALL MOUNT LIGHT
	FLOOD LIGHT
OUTLETS	
	DUPLEX OUTLET
GFI	GFI OUTLET
GFI–WP	WATERPROOF GFI OUTLET
	SWITCHED 1/2 HOT DUPLEX OUTLET
220v	220V OUTLET
	TELEPHONE OUTLET
	CATV (TELEVISION) OUTLET
	UNDER–COUNTER OR CONCEALED OUTLETS
	CEILING MOUNTED DUP. OUTLET
FLOOR	FLOOR MOUNTED DUP. OUTLET
SWITCHES	
$	SINGLE POLE SWITCH
$3	THREE–WAY SWITCH
$4	FOUR–WAY SWITCH
DIS	ELECTRICAL DISCONNECT
MISC FIXTURES	
	EXHAUST FAN
	JUNCTION BOX
220V	JUNCTION BOX 220V
CM SD	CARBON MONOXIDE DETECTOR OR SMOKE DETECTOR
CO.SD	CARBON MONOXIDE DETECTOR AND SMOKE DETECTOR
	ELECTRIC METER
Elec Panel	ELECTRICAL PANEL
	DOOR BELL CHIME
	DOOR BELL PUSH BUTTON
FROM ATTIC	CEILING FAN PREWIRE
	FLUORESCENT LIGHT

General Power and Lighting:

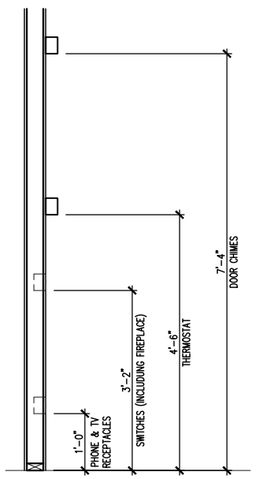
General Power and Lighting Notes shall apply unless noted otherwise on plans.

All work shall be installed per the current NC Residential Building Code, and the National Electric Code. Alarm devices shall meet NFPA 72.

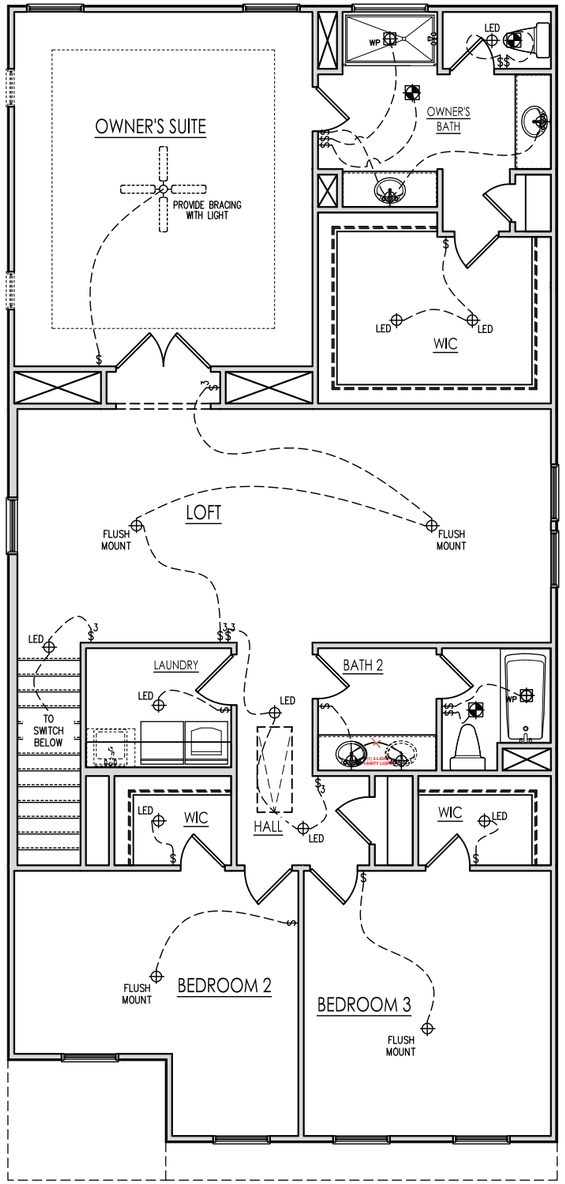
1. **Smoke Alarms - Shall be provided as a minimum of (1) per floor, including basements (if applicable), (1) in each sleep room, and (1) outside each sleeping area, within the immediate vicinity of sleeping rooms. When more than one alarm is required, the alarm devices shall be interconnected in such a manner that the activation of one alarm will activate all of the alarms. Smoke alarms shall be hard wired to permanent power and shall have batter back-ups.**

2. **Switches - For lighting, fans, etc. shall be installed at heights illustrated on this page and shall be located a minimum of 4 1/2" from door openings to allow for the proper installation of door casings. Switches, thermostats, security pads, and other similar devices shall be grouped together and installed thoughtfully for convenience of use and to avoid placement within centers of wall areas.**

Note:
This plan is a diagram showing approximate locations of convenience outlets based on requirements found in the NC Residential Code and N.E.C. Actual positions may vary from what is shown on plan.



ELECTRICAL BOX HEIGHTS



SECOND FLOOR ELECTRICAL PLAN 'A'
SCALE: 1/8"=1'–0" ON 11x17, 1/4"=1'–0" ON 22x34

DAVIDSON HOMES

REV #	DESCRIPTION	DATE
3	REDUCED OVERHANG TO 6"	05/15/2023
4	---	---
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---

2870 - THE PRESTON - RH

Second Floor Electrical 'A'

DRAWN BY: South Designs
ISSUE DATE: 06/06/2022
CURRENT REVISION DATE: 05/15/2023
SCALE: 1/8" = 1'-0"
SHEET 5.2a

WELLERS
KNOLL
LOT 49

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
www.kse-eng.com (215) 804-4449

2870 THE PRESTON

RH

RALEIGH, NORTH CAROLINA

DESIGN SPECIFICATIONS:

DESIGN BUILDING CODE (REFERRED TO HEREIN AS 'THE BUILDING CODE'):
- 2018 NORTH CAROLINA RESIDENTIAL CODE. WALL BRACING PER INTERNATIONAL RESIDENTIAL CODE 2015 EDITION.

DESIGN LIVE LOADS:
- ROOF = 20 PSF (LOAD DURATION FACTOR=1.25)
- UNINHABITABLE ATTICS WITH LIMITED STORAGE = 20 PSF (WHERE SPECIFIED ON PLANS)
- HABITABLE ATTICS AND ATTICS SERVED WITH FIXED STAIRS = 30 PSF
- FLOOR = 40 PSF
- FLOOR (SLEEPING AREAS) = 30 PSF
- DECK/BALCONY = 40 PSF
- STAIRS = 40 PSF

DESIGN DEAD LOADS:
- ROOF TRUSS = 17 PSF (TC=7, BC=10)
- FLOOR TRUSS = 15 PSF (TC=10, BC=5)
- FLOOR JOIST = 10 PSF
- STANDARD BRICK = 40 PSF
- QUEEN ANNE BRICK = 25 PSF

NOTE: STRUCTURAL FRAMING HAS NOT BEEN DESIGNED FOR TILE, GRANITE, MARBLE OR OTHER MATERIALS HEAVIER THAN THE ABOVE LOADING UNLESS SPECIFICALLY NOTED ON PLANS..

DESIGN WIND LOADS:
- ULTIMATE WIND SPEED = 120 MPH
- EXPOSURE CATEGORY = B

ASSUMED SOIL BEARING CAPACITY = 2000 PSF

ASSUMED LATERAL SOIL PRESSURE = 45 PCF

FROST DEPTH = 12" MINIMUM

SEISMIC DESIGN CATEGORY = B

ENGINEERED LUMBER SHALL HAVE THE FOLLOWING MINIMUM DESIGN VALUES:
- TJI 210 SERIES (SERIES AND SPACING PER PLANS)
- LSL: E=1,550,000 PSI, F_B=2,325 PSI, F_V=310 PSI, F_C=900 PSI
- LVL: E=2,000,000 PSI, F_B=2,600 PSI, F_V=285 PSI, F_C=750 PSI
- PSL: E=2,100,000 PSI, F_B=2,900 PSI, F_V=290 PSI, F_C=625 PSI

THIS PLAN HAS BEEN DESIGNED PER THE 2018 EDITION OF THE NC RESIDENTIAL CODE. WHERE FRAMING, FOUNDATION, OR OTHER STRUCTURAL ITEMS DO NOT COMPLY WITH THE PRESCRIPTIVE METHODS OF THE CODE, THOSE ITEMS HAVE BEEN DESIGNED IN ACCORDANCE WITH ACCEPTED ENGINEERING PRACTICE PER NCRC R301.1.3.

NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046096 ENGINEER ANDREW A. MOORE
3/9/23

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
www.kse-eng.com (215) 804-4449

DAVIDSON HOMES

Cover Sheet
2870 The Preston Model - RH
Up to 120 M.P.H.
Raleigh, North Carolina

Project #:	214-22005
Designed By:	AAM
Checked By:	KRK
Issue Date:	7/12/22
Re-Issue:	3/9/23
Scale:	1/8"=1'-0" @ 11x17 1/4"=1'-0" @ 22x34

S-0

GENERAL STRUCTURAL NOTES:

1. THE DESIGN PROFESSIONAL WHOSE SEAL APPEARS ON THESE DRAWINGS IS THE STRUCTURAL ENGINEER OF RECORD (SER) FOR THIS PROJECT. THE SER BEARS THE RESPONSIBILITY OF THE PRIMARY STRUCTURAL ELEMENTS AND THE PERFORMANCE OF THIS STRUCTURE. NO OTHER PARTY MAY REVISE, ALTER, OR DELETE ANY STRUCTURAL ASPECTS OF THESE CONSTRUCTION DOCUMENTS WITHOUT WRITTEN CONSENT OF KSE ENGINEERING, P.C. OR THE SER. FOR THE PURPOSES OF THESE CONSTRUCTION DOCUMENTS, THE SER AND KSE ENGINEERING SHALL BE CONSIDERED THE SAME ENTITY.
2. THE STRUCTURE IS ONLY STABLE IN ITS COMPLETED FORM. THE CONTRACTOR SHALL PROVIDE ALL REQUIRED TEMPORARY BRACING DURING CONSTRUCTION TO STABILIZE THE STRUCTURE.
3. THE SER IS NOT RESPONSIBLE FOR CONSTRUCTION SEQUENCES, METHODS, OR TECHNIQUES IN CONNECTION WITH THE CONSTRUCTION OF THIS STRUCTURE. THE SER WILL NOT BE HELD RESPONSIBLE FOR THE CONTRACTOR'S FAILURE TO CONFORM TO THE CONTRACT DOCUMENTS, SHOULD ANY NON-CONFORMITIES OCCUR.
4. THE SER DOES NOT CERTIFY DIMENSIONAL ACCURACY OR ARCHITECTURAL LAYOUT INCLUDING ROOF GEOMETRY. THE SER ASSUMES NO LIABILITY FOR CHANGES MADE TO THESE PLANS BY OTHERS, OR FOR CONSTRUCTION METHODS, OR FOR ANY DEVIATION FROM THE PLANS. THE SER SHALL BE NOTIFIED PRIOR TO CONSTRUCTION IF ANY DISCREPANCIES ARE NOTED ON THE PLANS.
5. ANY STRUCTURAL ELEMENTS OR DETAILS NOT FULLY DEVELOPED ON THE CONSTRUCTION DRAWINGS SHALL BE COMPLETED UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER. THESE SHOP DRAWINGS SHALL BE SUBMITTED TO KSE ENGINEERING FOR REVIEW BEFORE ANY CONSTRUCTION BEGINS. THE SHOP DRAWINGS WILL BE REVIEWED FOR OVERALL COMPLIANCE AS IT RELATES TO THE STRUCTURAL DESIGN OF THIS PROJECT. VERIFICATION OF THE SHOP DRAWINGS FOR DIMENSIONS, OR FOR ACTUAL FIELD CONDITIONS, IS NOT THE RESPONSIBILITY OF THE SER OR KSE ENGINEERING, P.C.
6. VERIFICATION OF ASSUMED FIELD CONDITIONS IS NOT THE RESPONSIBILITY OF THE SER. THE CONTRACTOR SHALL VERIFY THE FIELD CONDITIONS FOR ACCURACY AND REPORT ANY DISCREPANCIES TO KSE ENGINEERING, P.C. BEFORE CONSTRUCTION BEGINS.
7. THE SER IS NOT RESPONSIBLE FOR ANY SECONDARY STRUCTURAL ELEMENTS OR NON-STRUCTURAL ELEMENTS, EXCEPT FOR THE ELEMENTS SPECIFICALLY NOTED ON THE STRUCTURAL DRAWINGS.
8. THIS STRUCTURE AND ALL CONSTRUCTION SHALL CONFORM TO ALL APPLICABLE SECTIONS OF THE BUILDING CODE AND ANY LOCAL CODES OR RESTRICTIONS.
9. DO NOT SCALE DRAWINGS. WRITTEN DIMENSIONS TAKE PRECEDENCE OVER SCALED DIMENSIONS. ALL DIMENSIONS ARE TO FACE OF STUD OR TO FACE OF FRAMING UNLESS OTHERWISE NOTED.
10. PROVIDE MOISTURE PROTECTION AND FLASHING PER ARCHITECTURAL DETAILS.

FOUNDATIONS:

1. FOUNDATIONS SHALL BE CONSTRUCTED IN ACCORDANCE WITH CHAPTER 4 OF THE BUILDING CODE.
2. CONTRACTOR IS SOLELY RESPONSIBLE FOR VERIFYING THE SUITABILITY OF THE SITE SOIL CONDITIONS AT THE TIME OF CONSTRUCTION. THE BUILDER SHALL FURNISH ANY AND ALL REPORTS RECEIVED FROM THE GEOTECHNICAL ENGINEER ON THE STUDY OF THE PROPOSED SITE TO THE DESIGNER, STRUCTURAL ENGINEER, AND GENERAL CONTRACTOR.
3. MAXIMUM DEPTH OF UNBALANCED FILL AGAINST MASONRY WALLS TO BE AS SPECIFIED IN THE BUILDING CODE.
4. THE SER HAS NOT PERFORMED A SUBSURFACE INVESTIGATION. VERIFICATION OF THE ASSUMED VALUE IS THE RESPONSIBILITY OF THE OWNER OR THE CONTRACTOR. SHOULD ANY ADVERSE SOIL CONDITION BE ENCOUNTERED, THE SER MUST BE CONTACTED BEFORE PROCEEDING.
5. THE BOTTOM OF ALL FOOTINGS SHALL EXTEND BELOW THE FROST LINE FOR THE REGION IN WHICH THE STRUCTURE IS TO BE CONSTRUCTED, BUT NOT LESS THAN A MINIMUM OF 12" BELOW GRADE. ALL FOOTINGS TO HAVE A MINIMUM PROJECTION OF 2" ON EACH SIDE OF FOUNDATION WALLS. MAXIMUM FOOTING PROJECTION SHALL NOT EXCEED THE THICKNESS OF THE FOOTING.
6. WOOD SILL PLATES SHALL BE ANCHORED TO THE FOUNDATION WITH ½" ANCHOR BOLTS WITH MINIMUM 7" EMBEDMENT, SPACED A MAXIMUM OF 6'-0" O.C. INSTALL MINIMUM 2 ANCHOR BOLTS PER SECTION, 12" MAXIMUM FROM CORNERS. ½" DIAMETER x 8" LONG SIMPSON TITEN HD OR USP SCREW-BOLT+ SCREWS MAY BE SUBSTITUTED ON A 1 FOR 1 BASIS.
7. ANY FILL SHALL BE PLACED UNDER THE DIRECTION OR RECOMMENDATION OF A LICENSED PROFESSIONAL ENGINEER. THE RESULTING SOIL SHALL BE COMPACTED TO A MINIMUM OF 95% MAXIMUM DRY DENSITY.
8. EXCAVATIONS OF FOOTINGS SHALL BE LINED TEMPORARILY WITH A 6 MIL POLYETHYLENE MEMBRANE IF PLACEMENT OF CONCRETE DOES NOT OCCUR WITHIN 24 HOURS OF EXCAVATION.
9. NO CONCRETE SHALL BE PLACED AGAINST ANY SUBGRADE CONTAINING WATER, ICE, FROST, OR LOOSE MATERIAL.
10. PROVIDE FOUNDATION WATERPROOFING AND DRAIN WITH POSITIVE SLOPE TO OUTLET AS REQUIRED BY SITE CONDITIONS (SEE ARCHITECTURAL PLANS AND DETAILS).
11. NONE OF THE FOUNDATION DESIGNS IN THESE DOCUMENTS ARE SUITABLE FOR INSTALLATION IN SHRINK/SWELL CONDITIONS. REFER TO GEOTECHNICAL ENGINEER FOR APPROPRIATE DESIGN.
12. LOTS SHALL BE GRADED TO DRAIN SURFACE WATER AWAY FROM FOUNDATION WALLS. THE GRADE SHALL FALL A MINIMUM OF 6 INCHES WITHIN THE FIRST TEN FEET.
13. CRAWL SPACE TO BE GRADED LEVEL AND CLEAR OF ALL DEBRIS.
14. PROVIDE MINIMUM 6 MIL APPROVED VAPOR BARRIER. ALL JOINTS TO BE LAPPED MINIMUM 12" AND SEALED.

CONCRETE & REINFORCING

1. CONCRETE DESIGN BASED ON ACI 318 AND ACI 318.1 OR ACI 332. CONCRETE SHALL HAVE A NORMAL WEIGHT AGGREGATE AND A MINIMUM COMPRESSIVE STRENGTH (f'c) = 3,000 PSI MINIMUM AT 28 DAYS PER CODE (VARIES W/ WEATHER), UNLESS OTHERWISE NOTED ON THE PLAN.
2. CONCRETE SHALL BE PROPORTIONED, MIXED, AND PLACED IN ACCORDANCE WITH THE LATEST EDITIONS OF ACI 318: "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE" AND ACI 301: "SPECIFICATIONS FOR STRUCTURAL CONCRETE FOR BUILDINGS".
3. AIR ENTRAINED CONCRETE MUST BE USED FOR ALL STRUCTURAL ELEMENTS EXPOSED TO FREEZE/THAW CYCLES AND DEICING CHEMICALS. AIR ENTRAINMENT AMOUNTS (IN PERCENT) SHALL BE WITHIN -1% TO +2% OF 5% FOR FOOTINGS AND EXTERIOR SLABS.
4. NO ADMIXTURES SHALL BE ADDED TO ANY STRUCTURAL CONCRETE WITHOUT WRITTEN PERMISSION OF THE SER. WATER ADDED TO CONCRETE ON SITE SHALL NOT EXCEED THAT ALLOWED BY THE MIX DESIGN.
5. CONCRETE SLABS-ON-GRADE SHALL BE CONSTRUCTED IN ACCORDANCE WITH ACI 302.1R: "GUIDE FOR CONCRETE SLAB AND SLAB CONSTRUCTION".
6. CONTROL OR SAW CUT JOINTS (CUT OR TOOLED) SHALL BE SPACED IN INTERIOR SLABS-ON-GRADE AT A MAXIMUM OF 15'-0" O.C. AND IN EXTERIOR SLABS-ON-GRADE AT A MAXIMUM OF 10'-0" UNLESS OTHERWISE NOTED. CARE SHALL BE TAKEN TO AVOID RE-ENTRANT CORNERS.
7. CONTROL OR SAW CUT JOINTS SHALL BE PRODUCED USING CONVENTIONAL CUT OR TOOLED PROCESSES WITHIN 4 TO 12 HOURS AFTER THE SLAB HAS BEEN FINISHED.
8. ALL WELDED WIRE FABRIC (W.W.F.) FOR CONCRETE SLABS-ON-GRADE SHALL BE PLACED AT MID-DEPTH OF SLAB. THE W.W.F. SHALL BE SECURELY SUPPORTED DURING THE CONCRETE POUR. FIBROUS CONCRETE REINFORCEMENT, OR POLYPROPYLENE FIBERS MAY BE USED IN LIEU OF W.W.F. APPLICATION OF POLYPROPYLENE FIBERS PER CUBIC YARD OF CONCRETE SHALL BE PER MANUFACTURER AND COMPLY WITH ASTM C1116, ANY LOCAL BUILDING CODE REQUIREMENTS AND SHALL MEET OR EXCEED CURRENT INDUSTRY STANDARD.
9. POLYPROPYLENE REINFORCING TO BE 100% VIRGIN, CONTAINING NO REPROCESSED OLEFIN MATERIALS AND SPECIFICALLY MANUFACTURED FOR USE AS CONCRETE SECONDARY REINFORCEMENT.
10. STEEL REINFORCING BARS SHALL BE NEW BILLET STEEL CONFORMING TO ASTM A615, GRADE 60.
11. DETAILING, FABRICATION, AND PLACEMENT OF REINFORCING STEEL SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF ACI 315: "MANUAL OF STANDARD PRACTICE FOR DETAILING CONCRETE STRUCTURES".
12. HORIZONTAL FOOTING AND WALL REINFORCEMENT SHALL BE CONTINUOUS AND SHALL HAVE 90° BENDS, OR CORNER BARS WITH THE SAME SIZE/SPACING AS THE HORIZONTAL REINFORCEMENT.
13. PROVIDE REINFORCEMENT LAP AS NOTED BELOW, UNLESS NOTED OTHERWISE:
    #4 BARS - 30" LENGTH
    #5 BARS - 38" LENGTH
    #6 BARS - 45" LENGTH
14. WHERE REINFORCING DOWELS ARE REQUIRED, THEY SHALL BE EQUIVALENT IN SIZE AND SPACING TO THE VERTICAL REINFORCEMENT. THE DOWEL SHALL EXTEND 48 BAR DIAMETERS VERTICALLY AND 20 BAR DIAMETERS INTO THE FOOTING. SEE KSE FOUNDATION DETAILS.
15. WHERE FOOTING BOTTOMS ARE TO BE STEPPED AT SLOPING GRADE CONDITIONS, PROVIDE CONTINUOUS REINFORCING WITH Z BARS (TO MATCH FOOTING REINFORCING) AS REQUIRED.
16. BAR SUPPORT ACCESSORIES SHALL BE PROVIDED IN ACCORDANCE WITH THE LATEST ACI MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES, EXCEPT THAT REINFORCING SHALL BE CHAIRED ON THE BOTTOM AND/OR THE SIDES ON BOLSTERS SPACED NOT MORE THAN 4 FEET ON CENTER. NO ROCKS, CMU, CLAY TILE, OR BRICK SHALL BE USED TO SUPPORT REINFORCING.
17. FOR GRADE SUPPORTED SLABS, SLAB REINFORCING SHALL BE HELD IN PLACE BY BAR SUPPORTS AND ACCESSORIES AS DESCRIBED IN THE CRSI MANUAL OF STANDARD PRACTICE. BAR SUPPORTS SHALL BE SPACED A MAXIMUM OF 4'-0" O.C. BOTH WAYS IN STRAIGHT LINES ON THE MESH GRID.

MASONRY

1. ALL MASONRY SHALL CONFORM TO ASTM C-90, F'_m=1500 PSI. ALL BRICK SHALL CONFORM TO ASTM C-216, F'_m=1500 PSI. ALL MORTAR SHALL BE TYPE 'S' (TYPE 'M' BELOW GRADE) AND CONFORM TO ASTM C-270. COARSE GROUT SHALL CONFORM TO ASTM C-476 WITH A MAXIMUM AGGREGATE SIZE OF ⅜" AND A MINIMUM COMPRESSIVE STRENGTH OF 2,000 PSI.
2. ALL MASONRY WORK SHALL BE IN ACCORDANCE WITH "BUILDING CODE REQUIREMENTS FOR MASONRY STRUCTURES" ACI 530/ASCE 5/TMS 402 AND "SPECIFICATIONS FOR MASONRY STRUCTURES" ACI 530.1/ ASCE 6/TMS 602.
3. THE UNSUPPORTED HEIGHT OF SOLID MASONRY PIERS SHALL NOT EXCEED TEN TIMES THEIR LEAST DIMENSION. UNFILLED HOLLOW PIERS MAY BE USED IF THE UNSUPPORTED HEIGHT IS NOT MORE THAN FOUR TIMES THEIR LEAST DIMENSION.
4. EACH CRAWL SPACE PIER SHALL BEAR IN THE MIDDLE THIRD OF ITS RESPECTIVE FOOTING AND EACH GIRDER SHALL BEAR IN THE MIDDLE THIRD OF THE PIERS. PILASTERS TO BE BONDED TO PERIMETER FOUNDATION WALL.
5. TOP COURSE OF MASONRY SHALL BE GROUTED SOLID.
6. HORIZONTAL WALL JOINT REINFORCEMENT SHALL BE STANDARD 9 GAGE GALVANIZED LADDER OR TRUSS TYPE SPACED AT 16" O.C., UNLESS SHOWN OTHERWISE ON THE DRAWINGS.
7. SPLICED WIRE REINFORCEMENT SHALL BE LAPPED AT LEAST 6" AND CONTAIN AT LEAST ONE CROSS WIRE OF EACH PIECE OF REINFORCEMENT WITHIN THE 6". LAP WITH STANDARD 'T' AND 'L' SHAPED PIECES AT INTERSECTIONS AND CORNERS.

WOOD FRAMING:

1. SOLID SAWN WOOD FRAMING MEMBERS SHALL CONFORM TO THE SPECIFICATIONS LISTED IN THE LATEST EDITION OF THE "NATIONAL DESIGN SPECIFICATION FOR WOOD CONSTRUCTION": (NDS). UNLESS OTHERWISE NOTED, ALL WOOD FRAMING MEMBERS ARE DESIGNED TO BE:
   SPRUCE-PINE-FIR (SPF) WITH THE FOLLOWING MINIMUM DESIGN VALUES:
   E=1,400,000 PSI, F_b=875 PSI, F_v=135 PSI
   1.1. FRAMING: SPF #2.
   1.2. PLATES: SPF #2.
   1.3. STUDS: SPF STUD GRADE.
2. WALL STUD SPACING, (MAXIMUM 10' NOMINAL PLATE HEIGHT):
   1 & 2 STORY EXTERIOR AND INTERIOR BEARING:
   2x4 @ 16" O.C. OR 2x6 @ 24" O.C., U.N.O.
   BOTTOM OF 3 STORIES EXTERIOR AND INTERIOR BEARING:
   2x6 @ 16" O.C., U.N.O.
   INTERIOR NON-BEARING:
   2x @ 24" O.C., U.N.O.
3. ALL LUMBER EXPOSED TO WEATHER OR IN CONTACT WITH CONCRETE SHALL BE PRESERVATIVE TREATED SOUTHERN YELLOW PINE #2 OR BETTER.
4. ANCHOR SILL PLATES IN ACCORDANCE W/ GENERAL STRUCTURAL NOTES.
5. ALL BEAMS SPECIFIED ARE MINIMUM SIZES ONLY. LARGER MEMBERS MAY BE SUBSTITUTED AS NEEDED FOR EASE OF CONSTRUCTION.
6. NAILS SHALL BE COMMON WIRE NAILS UNLESS OTHERWISE NOTED.
7. BOLT HOLES AND LEAD HOLES FOR LAG SCREWS SHALL BE IN ACCORDANCE WITH NDS SPECIFICATIONS.
8. INDIVIDUAL STUDS FORMING A COLUMN SHALL BE ATTACHED WITH (2) ROWS 10d NAILS @ 6" O.C. STAGGERED. THE STUD COLUMN SHALL BE FULLY BLOCKED AT ALL FLOOR LEVELS TO ENSURE PROPER LOAD TRANSFER. WALL SHEATHING SHALL BE NAILED TO EDGE OF EACH STUD.
9. FACE NAIL ALL MULTI-PLY BEAMS AND HEADERS WITH (2) ROWS 16d COMMON NAILS @ 16" O.C., STAGGERED, OR PER MANUFACTURER'S SPECIFICATIONS FOR ENGINEERED LUMBER. APPLY NAILING FROM BOTH FACES FOR (3) OR MORE PLIES.
10. FASTEN 4-PLY BEAMS WITH (1) ½" DIAMETER THROUGH BOLT W/ NUTS AND WASHERS AT 12" O.C. STAGGERED TOP AND BOTTOM, 1½" MINIMUM EDGE DISTANCE. (UNLESS OTHERWISE NOTED)
11. ALL BEAMS AND HEADERS SHALL HAVE (1)2x JACK STUD & (1)2x KING STUD UNLESS OTHERWISE NOTED. THE NUMBER OF STUDS INDICATED ON PLANS ARE THE TOTAL NUMBER OF JACK STUDS REQUIRED, UNLESS OTHERWISE NOTED.
12. PROVIDE KING STUDS AT EACH END OF HEADERS AS NOTED BELOW.
    (1) STUD UP TO 6' OPENING
    (2) STUDS UP TO 8' OPENING
    (3) STUDS UP TO 9' OPENING
13. ALL BEAMS TO BE CONTINUOUSLY SUPPORTED LATERALLY AND SHALL BEAR FULL WIDTH ON THE SUPPORTING WALLS OR COLUMNS INDICATED WITH A MINIMUM OF TWO STUDS, UNLESS OTHERWISE NOTED. ALL BEAM SPLICES SHALL OCCUR OVER SUPPORTS.
14. SOLID BLOCKING TO BE PROVIDED AT ALL POINT LOADS THROUGH FLOOR LEVELS TO THE FOUNDATION OR TO OTHER STRUCTURAL COMPONENTS.
15. ALL LUMBER SPECIFIED ON DRAWINGS IS INTENDED FOR DRY USE ONLY (MOISTURE CONTENT <19%) UNLESS OTHERWISE NOTED.
16. ALL WATERPROOFING AND FIRE SAFETY SYSTEMS ARE THE RESPONSIBILITY OF THE CONTRACTOR AND ARE TO BE DESIGNED AND DETAILED BY OTHERS.
17. ANY WOOD FRAME INTERIOR BEARING WALL STUDS THAT HAVE HOLES IN THE CENTER OF THE STUD UP TO 1" DIAMETER SHALL HAVE STUD PROTECTION SHIELDS. ALL HOLES OVER 1" IN DIAMETER FOR PLUMBING LINES, ETC. SHALL BE REPAIRED WITH SIMPSON HSS2 OR USP STS1 STUD SHOES, TYPICAL, UNLESS OTHERWISE NOTED.
18. BEARING WALLS SHALL BE SHEATHED ON NOT LESS THAN ONE SIDE WITH OSB OR GYPSUM BOARD. BRIDGING SHALL BE INSTALLED NOT GREATER THAN 4 FEET APART MEASURED VERTICALLY FROM EITHER END OF THE STUD IN LIEU OF SHEATHING.
19. DIAGONAL BRACING SHALL BE INSTALLED AT EACH END OF BASEMENT BEARING WALLS AND NOT MORE THAN 20' ON CENTER.

EXTERIOR WOOD FRAMED DECKS:

1. DECKS ARE TO BE FRAMED IN ACCORDANCE WITH APPLICABLE BUILDING CODES AND AS REFERENCED ON THE STRUCTURAL PLANS, EITHER THROUGH CODE REFERENCES OR CONSTRUCTION DETAILS.
2. PRESERVATIVE TREATED WOOD FRAMING TO BE SOUTHERN YELLOW PINE #2 OR BETTER.
3. GUARD RAILS REQUIRED AT DECKS. DESIGN BY OTHERS TO MEET MINIMUM CODE REQUIREMENTS.
4. PROVIDE DECK LATERAL LOAD AND BRACING CONNECTIONS PER BUILDING CODE.

RAFTER FRAMED ROOF CONSTRUCTION:

1. PROVIDE 2x4x4'-0" RAFTER TIES AT 48" O.C.
2. RAFTERS SHALL BE SUPPORTED BY PURLINS AND PURLIN BRACES AS SHOWN ON THE PLAN. PURLIN BRACES SHALL NOT BEAR ON ANY CEILING JOIST, STRONGBACK OR HEADER UNLESS SPECIFICALLY SHOWN ON PLAN. RAFTERS MAY BE SPLICED AT PURLIN LOCATIONS.
3. CEILING JOISTS SHALL HAVE LATERAL SUPPORT W/ 1x4 FLAT BRACING ON TOP EDGE OF JOIST AT LOOSE JOIST ENDS (WHERE JOISTS NOT FASTENED TO RAFTERS) OR FULL DEPTH BLOCKING. FASTEN END OF BRACING TO RAFTER OR GABLE END FRAMING.
4. FASTEN RAFTER AND CEILING JOIST WITH (6) 12d NAILS UNLESS OTHERWISE NOTED.
5. PROVIDE VERTICAL 2x6 STRONGBACKS AT CEILING JOISTS @ 8'-0" O.C. TIE STRONGBACK ENDS TO GABLE STUDS OR RAFTERS WHERE POSSIBLE. PROVIDE BLOCKING BETWEEN TOP PLATES AND STRONGBACKS. PROVIDE 2x4 FLAT FASTENED TO EACH JOIST WITH (2) 12d NAILS. FASTEN STRONGBACK TO 2x4 FLAT WITH 12d NAILS @ 12" O.C. AND FASTENED TO EACH JOIST WITH (1) 12d TOENAIL.

WOOD TRUSSES (FLOOR & ROOF):

1. THE WOOD TRUSS MANUFACTURER/FABRICATOR IS RESPONSIBLE FOR THE DESIGN OF THE WOOD TRUSSES. SUBMIT SEALED SHOP DRAWINGS AND SUPPORTING CALCULATIONS TO THE SER FOR REVIEW PRIOR TO FABRICATION. THE SER SHALL HAVE A MINIMUM OF (5) DAYS FOR REVIEW. THE REVIEW BY THE SER SHALL BE FOR OVERALL COMPLIANCE OF THE DESIGN DOCUMENTS. THE SER SHALL ASSUME NO RESPONSIBILITY FOR THE CORRECTNESS OF THE STRUCTURAL DESIGN FOR THE WOOD TRUSSES.
2. THE WOOD TRUSSES SHALL BE DESIGNED FOR ALL REQUIRED LOADINGS AS SPECIFIED IN THE LOCAL BUILDING CODE, THE ASCE STANDARD "MINIMUM DESIGN LOADS FOR BUILDINGS AND OTHER STRUCTURES." (ASCE 7), AND THE LOADING REQUIREMENTS SHOWN ON THESE SPECIFICATIONS. THE TRUSS DRAWINGS SHALL BE COORDINATED WITH ALL OTHER CONSTRUCTION DOCUMENTS AND PROVISIONS PROVIDED FOR LOADS SHOWN ON THESE DRAWINGS INCLUDING BUT NOT LIMITED TO HVAC EQUIPMENT, PIPING, AND ARCHITECTURAL FIXTURES ATTACHED TO THE TRUSSES.
3. THE TRUSSES SHALL BE DESIGNED, FABRICATED, AND ERECTED IN ACCORDANCE WITH THE LATEST EDITION OF THE ANSI/TPI 1: "NATIONAL DESIGN STANDARD FOR METAL PLATE CONNECTED WOOD TRUSS CONSTRUCTION".
4. THE TRUSS MANUFACTURER SHALL PROVIDE ADEQUATE BRACING INFORMATION IN ACCORDANCE WITH "BUILDING COMPONENT SAFETY INFORMATION GUIDE TO GOOD PRACTICE FOR HANDLING, INSTALLING, RESTRAINING & BRACING OF METAL PLATE CONNECTED WOOD TRUSSES" (BCSI). THIS BRACING, BOTH TEMPORARY AND PERMANENT, SHALL BE SHOWN ON THE SHOP DRAWINGS. ALSO, THE SHOP DRAWINGS SHALL SHOW THE REQUIRED ATTACHMENTS FOR THE TRUSSES.
5. THE CONTRACTOR IS RESPONSIBLE FOR INSTALLING TEMPORARY BRACING AND SHORING FOR THE FLOOR AND ROOF TRUSSES AS REQUIRED DURING CONSTRUCTION. AT A MINIMUM, CONTRACTOR SHALL FOLLOW THE REQUIREMENTS OF THE LATEST BCSI. THE CONTRACTOR SHALL KEEP A COPY OF THE BCSI SUMMARY SHEETS ON SITE.
6. THE CONTRACTOR IS RESPONSIBLE FOR INSTALLING ALL PERMANENT TRUSS BRACING SHOWN IN THE STRUCTURAL DRAWINGS AND IN THE TRUSS DESIGNS. ALL CONTINUOUS LATERAL BRACING OF WEBS REQUIRES BRACES. REFER TO BCSI SUMMARY SHEET B3 FOR TYPES OF DIAGONAL BRACES TO PROVIDE AT EACH CONTINUOUS LATERAL BRACE LINE. SUCH DIAGONAL BRACES SHALL NOT BE SPACED MORE THAN 20 FEET O.C. DIAGONAL BRACES SHALL BE FASTENED TO EACH TRUSS WEB WITH A MINIMUM OF TWO 10d FACE NAILS. WHERE CONTINUOUS LATERAL BRACING CANNOT BE INSTALLED, DUE TO A MINIMUM OF THREE ADJACENT TRUSSES NOT BEING IDENTICAL, THE CONTRACTOR SHALL COORDINATE WITH THE TRUSS SPECIALTY ENGINEER/MANUFACTURER TO DETERMINE WHAT TYPE OF ALTERNATE BRACE (I.E., T OR L BRACE, ETC.) IS REQUIRED.
7. ANY CHORDS OR TRUSS WEBS SHOWN ON THESE DRAWINGS HAVE BEEN SHOWN AS A REFERENCE ONLY. THE FINAL DESIGN OF THE TRUSSES SHALL BE PER THE MANUFACTURER.
8. TRUSS LAYOUT AND PLACEMENT BY MANUFACTURER TO COINCIDE WITH THE SUPPORT LOCATIONS SHOWN ON THE SEALED STRUCTURAL DRAWINGS. TRUSS PROFILES TO BE SEALED BY THE TRUSS MANUFACTURER. TRUSS PLANS TO BE COORDINATED WITH THE SEALED STRUCTURAL DRAWINGS.
9. TRUSS MANUFACTURER TO PROVIDE REQUIRED UPLIFT CONNECTORS FOR ALL TRUSSES.
10. PROVIDE SIMPSON H2.5A, USP RT7 OR EQUIVALENT AT EACH TRUSS TO TOP PLATE CONNECTION, UNLESS OTHERWISE NOTED.

WOOD STRUCTURAL PANELS:

1. FABRICATION AND PLACEMENT OF STRUCTURAL WOOD SHEATHING SHALL BE IN ACCORDANCE WITH THE APA DESIGN/CONSTRUCTION GUIDE "RESIDENTIAL AND COMMERCIAL," AND ALL OTHER APPLICABLE APA STANDARDS.
2. ALL REQUIRED WOOD SHEATHING SHALL BEAR THE MARK OF THE APA.
3. WOOD WALL SHEATHING SHALL COMPLY WITH THE REQUIREMENTS OF LOCAL BUILDING CODES FOR THE APPROPRIATE STATE AS INDICATED ON THESE DRAWINGS. REFER TO WALL BRACING NOTES IN PLAN SET FOR MORE INFORMATION. EXTERIOR WALLS TO BE FULLY SHEATHED USING 7/16" OSB OR PLYWOOD MINIMUM. AT BRACED WALL PANELS, PROVIDE BLOCKING AT ALL SHEET EDGES NOT FALLING ON STUDS OR PLATES.
4. ROOF SHEATHING SHALL BE APA RATED SHEATHING EXPOSURE 1 OR 2. ROOF SHEATHING SHALL BE CONTINUOUS OVER TWO SUPPORTS MINIMUM AND ATTACHED TO ITS SUPPORTING ROOF FRAMING WITH 8d NAILS AT 6" O.C. AT PANEL EDGES AND AT 12" O.C. IN PANEL FIELD UNLESS OTHERWISE NOTED ON THE PLANS. SHEATHING SHALL BE APPLIED WITH THE LONG DIRECTION PERPENDICULAR TO FRAMING. SHEATHING SHALL HAVE A SPAN RATING CONSISTENT WITH THE FRAMING SPACING. PROVIDE SUITABLE EDGE SUPPORT BY USE OF PLYWOOD CLIPS OR LUMBER BLOCKING UNLESS OTHERWISE NOTED. PANEL END JOINTS SHALL OCCUR OVER FRAMING. ROOF SHEATHING TO BE 7/16" OSB MINIMUM.
5. WOOD FLOOR SHEATHING SHALL BE APA RATED SHEATHING EXPOSURE 1 OR 2. ATTACH SHEATHING TO ITS SUPPORTING FRAMING WITH (1) 10d NAIL AT 6" O.C. AT PANEL EDGES AND AT 12" O.C. IN PANEL FIELD UNLESS OTHERWISE NOTED ON THE PLANS. SHEATHING SHALL BE APPLIED PERPENDICULAR TO FRAMING. SHEATHING SHALL HAVE A SPAN RATING CONSISTENT WITH THE FRAMING SPACING. PROVIDE SUITABLE EDGE SUPPORT BY USE OF T&G PLYWOOD OR LUMBER BLOCKING UNLESS OTHERWISE NOTED. PANEL END JOINTS SHALL OCCUR OVER FRAMING.
6. SHEATHING SHALL HAVE A ⅛" GAP AT PANEL ENDS AND EDGES AS RECOMMENDED IN ACCORDANCE WITH THE APA.

STRUCTURAL FIBERBOARD PANELS:

1. STRUCTURAL FIBERBOARD SHEATHING SHALL ONLY BE USED WHERE SPECIFICALLY NOTED ON THE STRUCTURAL PLANS.
2. FABRICATION AND PLACEMENT OF STRUCTURAL FIBERBOARD SHEATHING SHALL BE IN ACCORDANCE WITH THE APPLICABLE AFA STANDARDS.
3. FIBERBOARD WALL SHEATHING SHALL COMPLY WITH THE REQUIREMENTS OF LOCAL BUILDING CODES FOR THE APPROPRIATE STATE AS INDICATED ON THESE DRAWINGS. REFER TO WALL BRACING NOTES IN PLAN SET FOR MORE INFORMATION.
4. SHEATHING SHALL HAVE A ⅛" GAP AT PANEL ENDS AND EDGES AS RECOMMENDED IN ACCORDANCE WITH THE AFA.

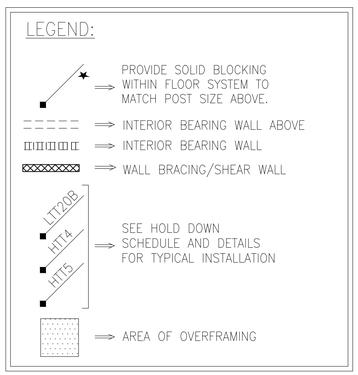
STRUCTURAL STEEL:

1. STRUCTURAL STEEL SHALL BE FABRICATED AND ERECTED IN ACCORDANCE WITH THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION "CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES" AND OF THE MANUAL OF STEEL CONSTRUCTION "LOAD RESISTANCE FACTOR DESIGN" LATEST EDITIONS.
2. ALL STEEL SHALL HAVE A MINIMUM YIELD STRESS (F_y) OF 50 KSI UNLESS OTHERWISE NOTED.
3. WELDING SHALL CONFORM TO THE LATEST EDITION OF THE AMERICAN WELDING SOCIETY'S STRUCTURAL WELDING CODE AWA D1.1. ELECTRODES FOR SHOP AND FIELDING WELDING SHALL BE CLASS E70XX. ALL WELDING SHALL BE PERFORMED BY A CERTIFIED WELDER PER THE ABOVE STANDARDS.
4. ALL STEEL BEAMS TO BE SUPPORTED AT EACH END WITH A MINIMUM BEARING LENGTH OF 3½" AND FULL FLANGE WIDTH UNLESS OTHERWISE NOTED. BEAMS MUST BE ATTACHED AT EACH END WITH A MINIMUM OF FOUR 16d NAILS OR (2) ½" x 4" LAG SCREWS UNLESS OTHERWISE NOTED.
5. INSTALL 2x WOOD PLATE ON TOP OF STEEL BEAMS, RIPPED TO MATCH BEAM WIDTH. FASTEN PLATE TO BEAM W/ HILTI X-DNI 52 P8 PINS AT 12" O.C. STAGGERED OR ½" DIAMETER BOLTS AT 24" O.C.

MECHANICAL FASTENERS:

1. ALL METAL HARDWARE AND FASTENERS TO BE SIMPSON STRONG-TIE OR APPROVED EQUIVALENT.
2. ALL HARDWARE AND FASTENERS IN CONTACT WITH PRESERVATIVE PRESSURE TREATED LUMBER SHALL BE HOT DIPPED GALVANIZED IN ACCORDANCE WITH ASTM A 153, G-185.
3. MANY OF THE NEW PRESSURE TREATED WOODS USE CHEMICALS THAT ARE CORROSIVE TO STEEL. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THE TYPE OF WOOD TREATMENT AND SELECT APPROPRIATE CONNECTORS THAT WILL RESIST THE APPLICABLE CORROSIVE CHEMICALS.

LEGEND:



BRICK VENEER LINTEL SCHEDULE

SPAN	LINTEL SIZE	END BEARING
UP TO 3'-0"	3½"x3½"x¼"	4"
UP TO 6'-3"	5"x3½"x5/16" L.L.V.	8"
UP TO 9'-6"	6"x3½"x5/16" L.L.V.	12"

LINTELS ARE NOT DESIGNED TO BE BOLTED TO HEADERS UNLESS SPECIFIED ON UNIT PLANS.
SPANS OVER 4'-0" SHALL BE SHORED UP UNTIL CURED.

NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046936 ENGINEER ANDREW A. MOORE
3/9/23

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

DAVIDSON HOMES

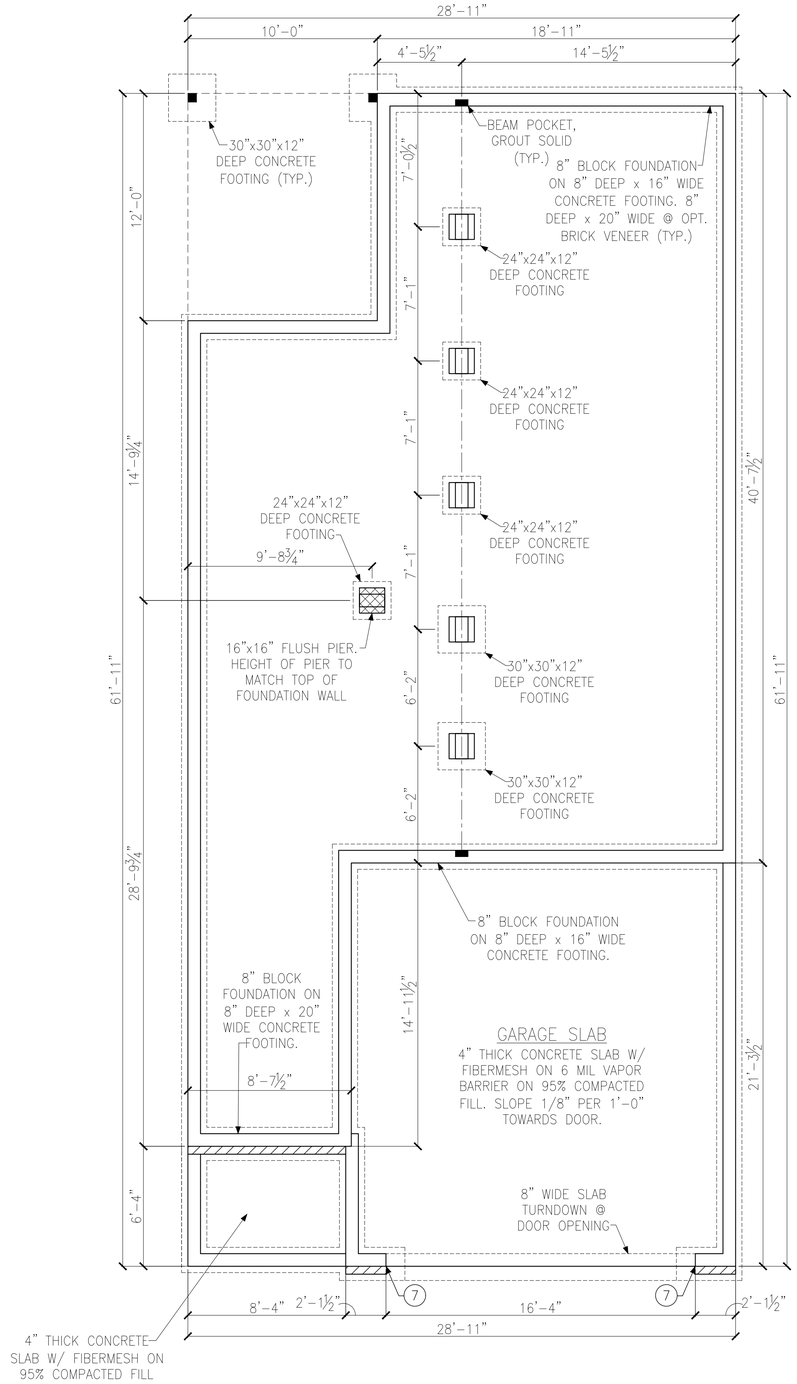
General Structural Notes

Up to 120 M.P.H.
Raleigh, North Carolina

Project #:	214-22000
Designed By:	KRK
Checked By:	
Issue Date:	3/6/23
Re-Issue:	
Scale:	1/8"=1'-0" @ 11x17 1/4"=1'-0" @ 22x34

S-0.1

WELLERS KNOLL LOT 49

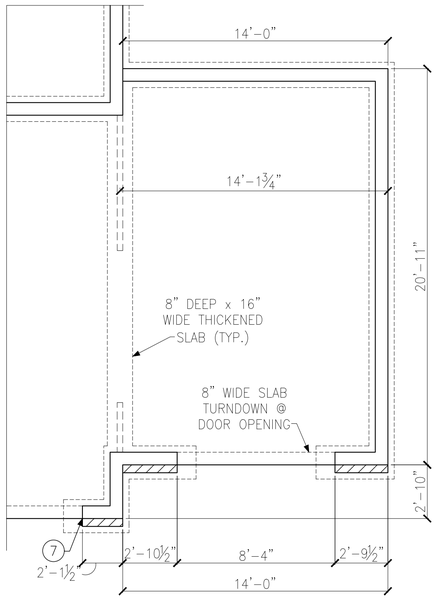


CRAWL SPACE FOUNDATION PLAN
ELEVATION 'A'

FOUNDATION PLAN FOR 2x10 FLOOR FRAMING

SEE PIER AND FOOTING SCHEDULE (TYP.)

PIER ELEV. TO BE 9¼" BELOW TOP OF WALL ELEV. (TYP.)



PARTIAL FOUNDATION PLAN
OPT. 3 CAR FRONT LOAD

LEGEND

- ★ ⟹ PROVIDE SOLID BLOCKING WITHIN FLOOR SYSTEM TO MATCH POST SIZE ABOVE.
- ⟹ BEARING WALL ABOVE
- ⟹ INTERIOR BEARING WALL
- 48" WSP ⟹ BRACED WALL PANEL (SEE KSE STRUCTURAL DETAILS SET FOR BRACED WALL PANEL SHEATHING FASTENING & BLOCKING DETAILS)

REFER TO KSE STRUCTURAL DETAILS SET FOR GENERAL STRUCTURAL NOTES AND TYPICAL DETAILS

KEYNOTES:

(7) REINFORCE 8" CMU WALL AND FOOTING UNDER PORTAL FRAME PER DETAIL A OR B/SD-4.

NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046996 ENGINEER ANDREW A. MOORING
3/9/23

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

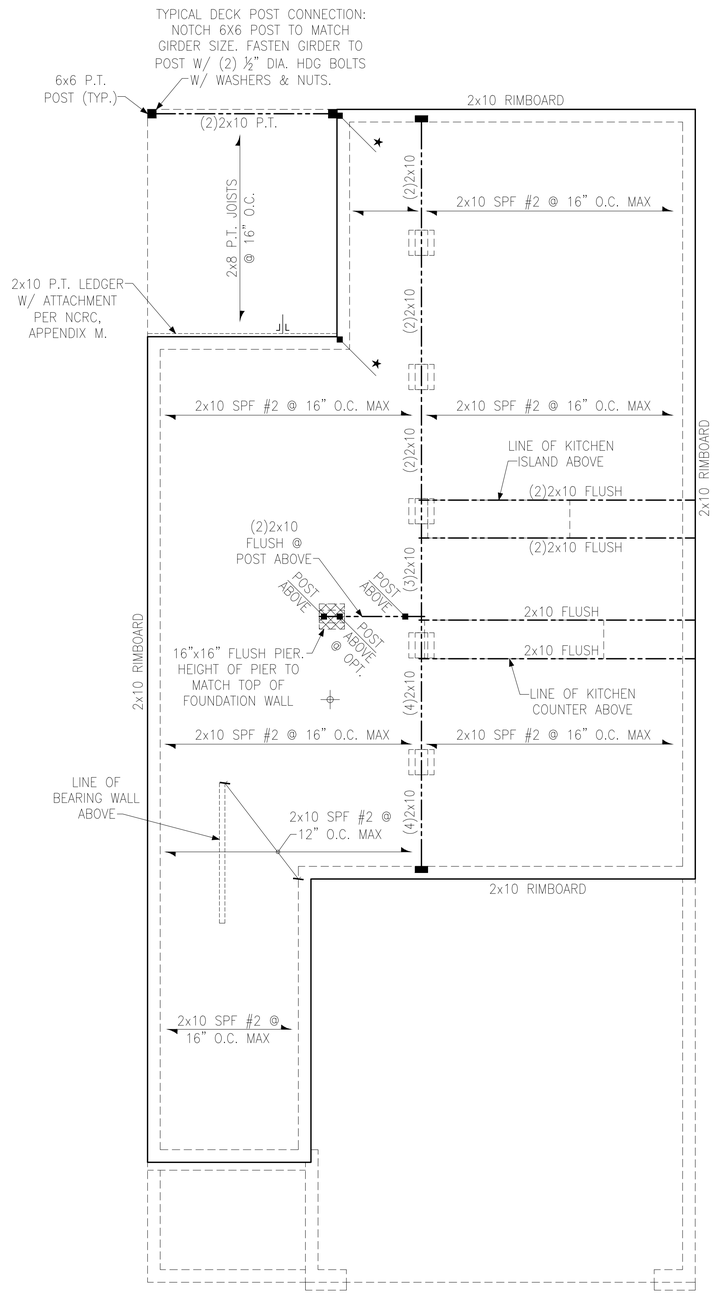
DAVIDSON HOMES

Crawl Space Foundation Plans – 2x10 Joists
Elevation 'A' & Option
2870 The Preston Model – RH
Up to 120 M.P.H.
Raleigh, North Carolina

Project #:	214-22005
Designed By:	AAM
Checked By:	KRK
Issue Date:	7/12/22
Re-Issue:	3/9/23
Scale:	1/8"=1'-0" @ 11x17 1/4"=1'-0" @ 22x34

S-1.12

DECK FRAMING NOTES:
-DECK CONSTRUCTION PER NCRC, APPENDIX M, U.N.O.
-GUARD RAIL REQUIRED, DESIGN BY OTHERS (TYP.)
-PROVIDE LATERAL BRACING PER NCRC, APPENDIX M.
-4'-0" MAXIMUM HEIGHT FROM GRADE TO DECKING.
-EMBED POST 12" MINIMUM INTO COMPACTED FILL.
-ALL DECKS OVER 4'-0" HEIGHT FROM GRADE MUST MEET OR EXCEED REQUIREMENTS OF APPENDIX M OF NCRC 2018.



LOCATE DOUBLE (2)2x10 FLUSH EACH END OF KITCHEN ISLAND

CRAWL SPACE FRAMING PLAN
ELEVATION 'A'

NOTE:
BEAMS, HEADERS AND FLOOR JOISTS MAY BE SYP #2 GRADE LUMBER.

LEGEND

- ★ ⟹ PROVIDE SOLID BLOCKING WITHIN FLOOR SYSTEM TO MATCH POST SIZE ABOVE.
- ⟹ BEARING WALL ABOVE
- ⟹ INTERIOR BEARING WALL
- 48" WSP ⟹ BRACED WALL PANEL (SEE KSE STRUCTURAL DETAILS SET FOR BRACED WALL PANEL SHEATHING FASTENING & BLOCKING DETAILS)

REFER TO KSE STRUCTURAL DETAILS SET FOR GENERAL STRUCTURAL NOTES AND TYPICAL DETAILS

FLOOR FRAMING TO BE 2x10 SPF #2 @ 16" O.C. MAX OR EQUAL (U.N.O.).

NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046986 ENGINEER ANDREW A. MOORE
3/9/23

WELLERS KNOLL LOT 49

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

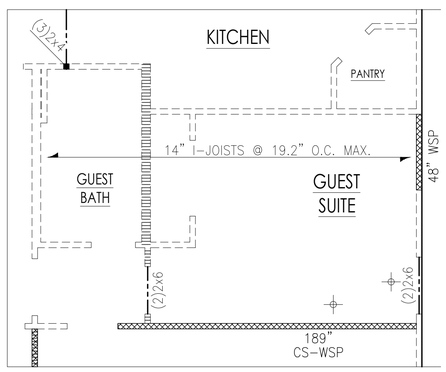
DAVIDSON HOMES

Crawl Space Framing Plan – 2x10 Joists
Elevation 'A'
2870 The Preston Model – RH
Up to 120 M.P.H.
Raleigh, North Carolina

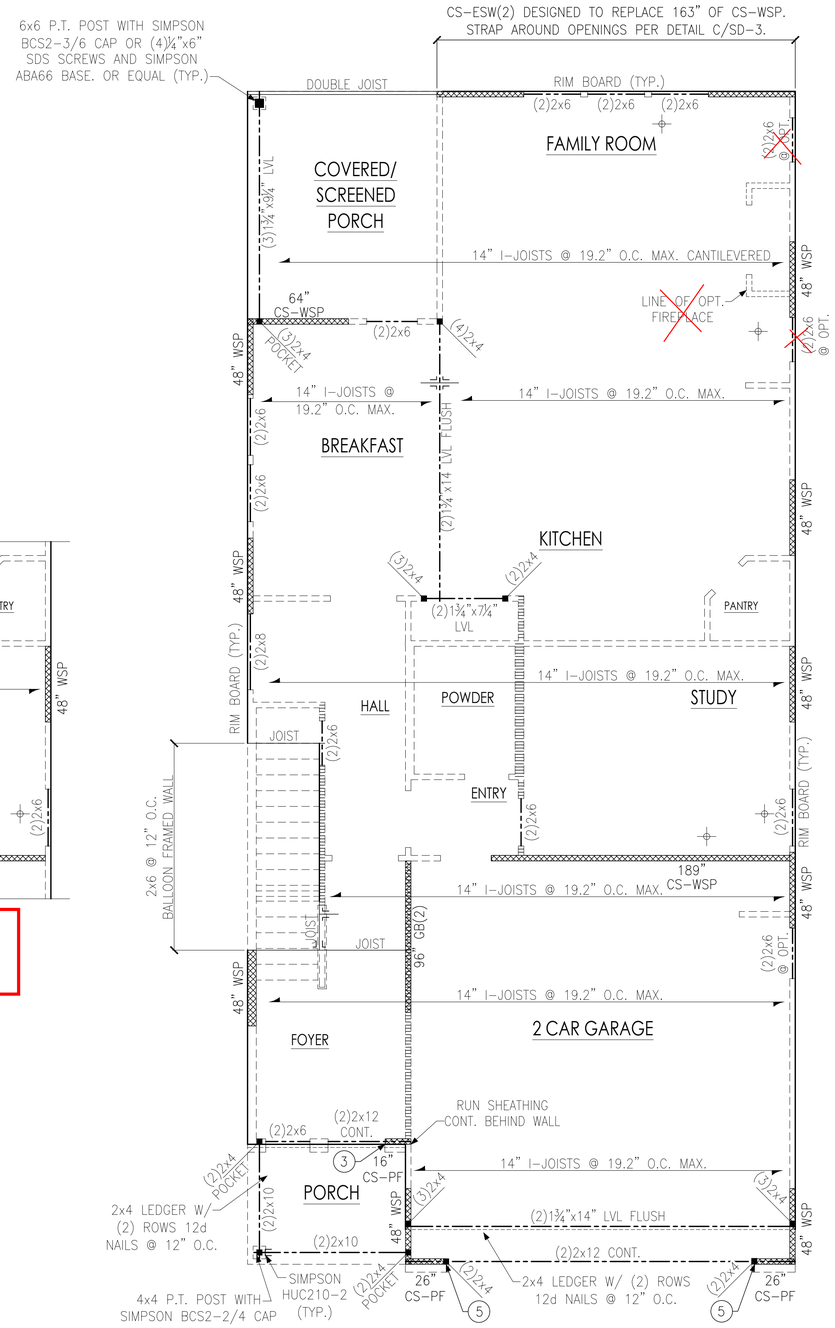
Project #:	214-22005
Designed By:	AAM
Checked By:	KRK
Issue Date:	7/12/22
Re-Issue:	3/9/23
Scale:	1/8"=1'-0" @ 11x17 1/4"=1'-0" @ 22x34

S-2.3

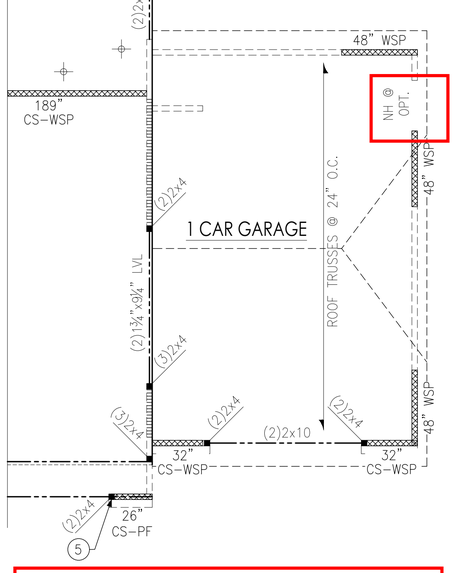
WELLERS KNOLL LOT 49



PARTIAL FRAMING PLAN
OPT. GUEST SUITE



SECOND FLOOR FRAMING PLAN
ELEVATION 'A'



PARTIAL FRAMING PLAN
OPT. 3 CAR FRONT LOAD

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

DAVIDSON HOMES

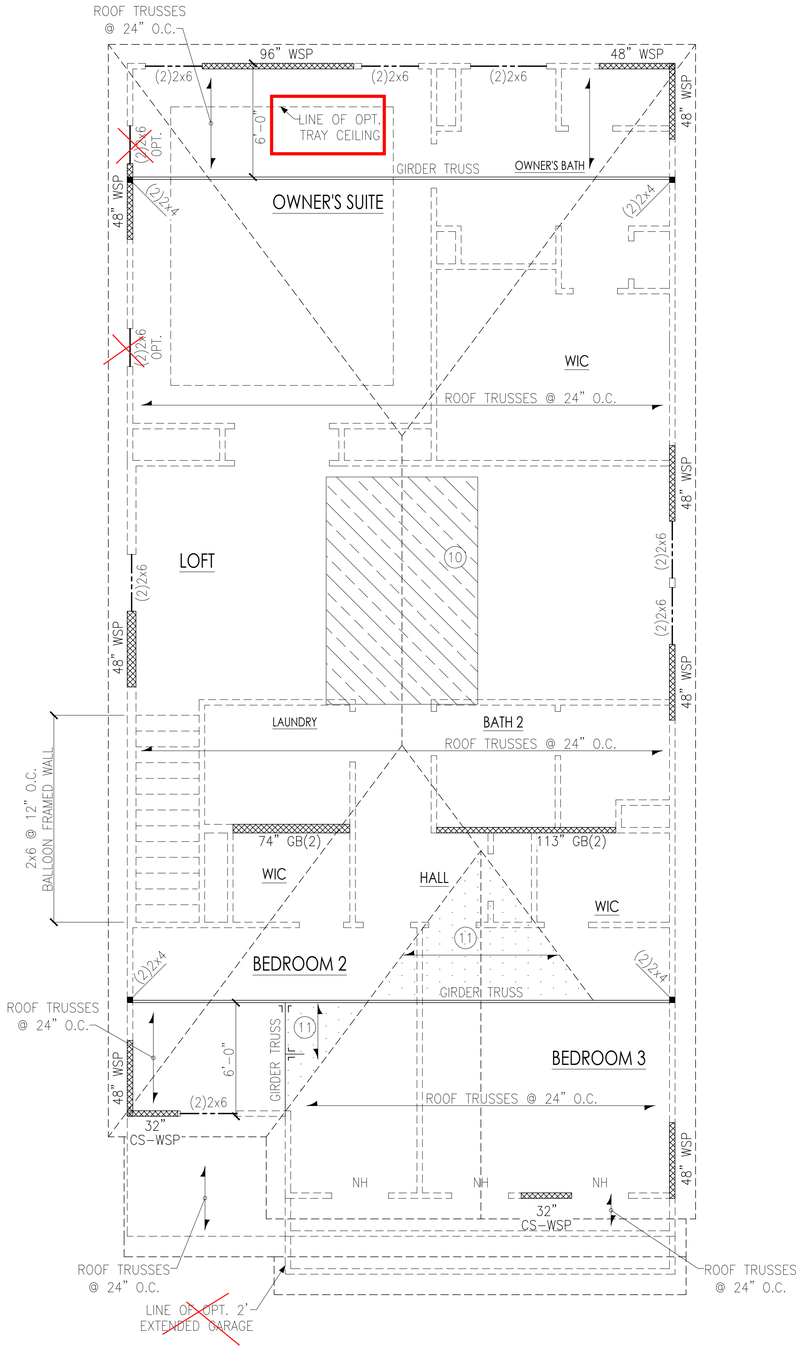
Second Floor Framing Plans - I-Joists
Elevation 'A' & Options
2870 The Preston Model - RH
Up to 120 M.P.H.
Raleigh, North Carolina

Project #:	214-22005
Designed By:	AAM
Checked By:	KRK
Issue Date:	7/12/22
Re-Issue:	3/9/23
Scale:	1/8"=1'-0" @ 11x17 1/4"=1'-0" @ 22x34

NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 045026 ANDREW A. MOORE
3/9/23

S-3J

WELLERS
KNOLL
LOT 49



ROOF FRAMING PLAN
ELEVATION 'A'

NOTE:
BEAMS, HEADERS AND FLOOR JOISTS MAY BE SYP #2 GRADE LUMBER.

LEGEND

- ★ ⟹ PROVIDE SOLID BLOCKING WITHIN FLOOR SYSTEM TO MATCH POST SIZE ABOVE.
- ⟹ BEARING WALL ABOVE
- ⟹ INTERIOR BEARING WALL
- 48" WSP ⟹ BRACED WALL PANEL (SEE KSE STRUCTURAL DETAILS SET FOR BRACED WALL PANEL SHEATHING FASTENING & BLOCKING DETAILS)
- NH ⟹ NO HEADER REQUIRED

REFER TO KSE STRUCTURAL DETAILS SET FOR GENERAL STRUCTURAL NOTES AND TYPICAL DETAILS

PLAN DESIGNED WITH 8' WALL PLATES

KEYNOTES:

(10) 8'x12' HVAC PLATFORM TRUSSES DESIGNED TO SUPPORT HVAC UNITS.

(11) VALLEY SET TRUSSES @ 24" O.C. OR 2x6 OVERFRAMING @ 24" O.C. W/ 2x8 RIDGE & VALLEY PLATES (TYP.)

NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046696 ENGINEER ANDREW A. MOORE
3/9/23

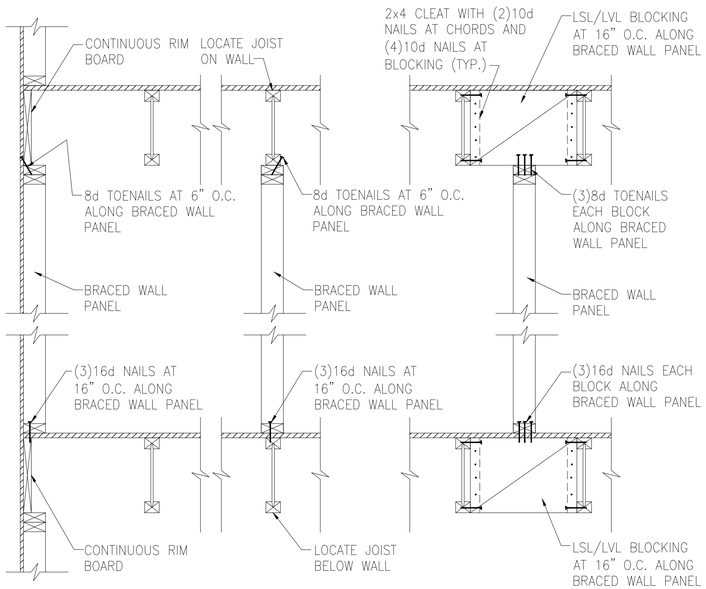
KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

DAVIDSON HOMES

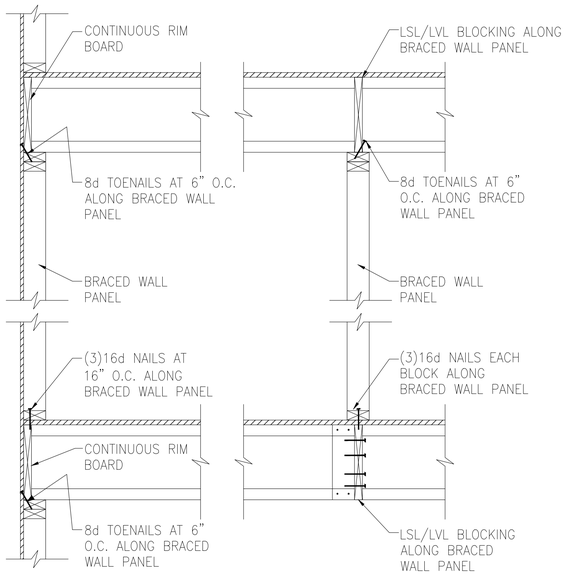
Roof Framing Plan
Elevation 'A'
2870 The Preston Model – RH
Up to 120 M.P.H.
Raleigh, North Carolina

Project #:	214-22005
Designed By:	AAM
Checked By:	KRK
Issue Date:	7/12/22
Re-Issue:	3/9/23
Scale:	1/8"=1'-0" @ 11x17 1/4"=1'-0" @ 22x34

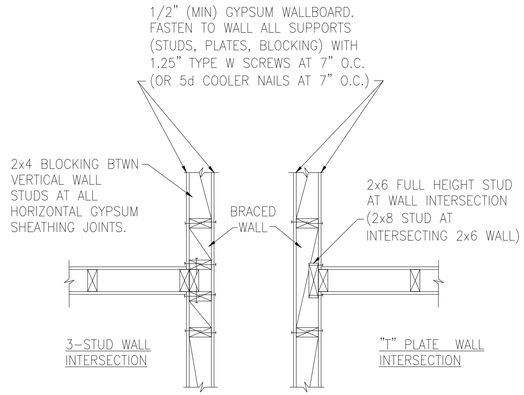
S-4



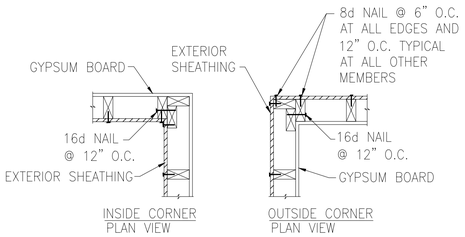
A TYPICAL BRACED WALL PANEL TO FLOOR/CEILING CONNECTION
BRACED WALL PANELS PARALLEL TO I-JOISTS



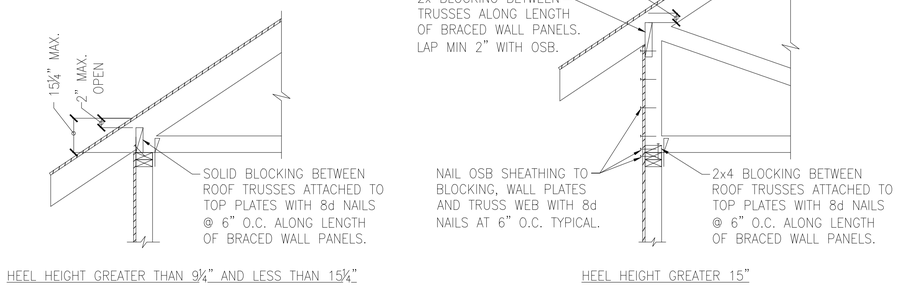
B TYPICAL BRACED WALL PANEL TO FLOOR/CEILING CONNECTION
BRACED WALL PANELS PERPENDICULAR TO I-JOISTS



C METHOD GB(1) AND GB(2) INTERSECTION DETAILS



D TYPICAL EXTERIOR CORNER WALL FRAMING



E ROOF TRUSS BEARING/BLOCKING AT BRACED WALL PANELS
ONLY REQUIRED AT BRACED WALL PANELS

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

DAVIDSON HOMES

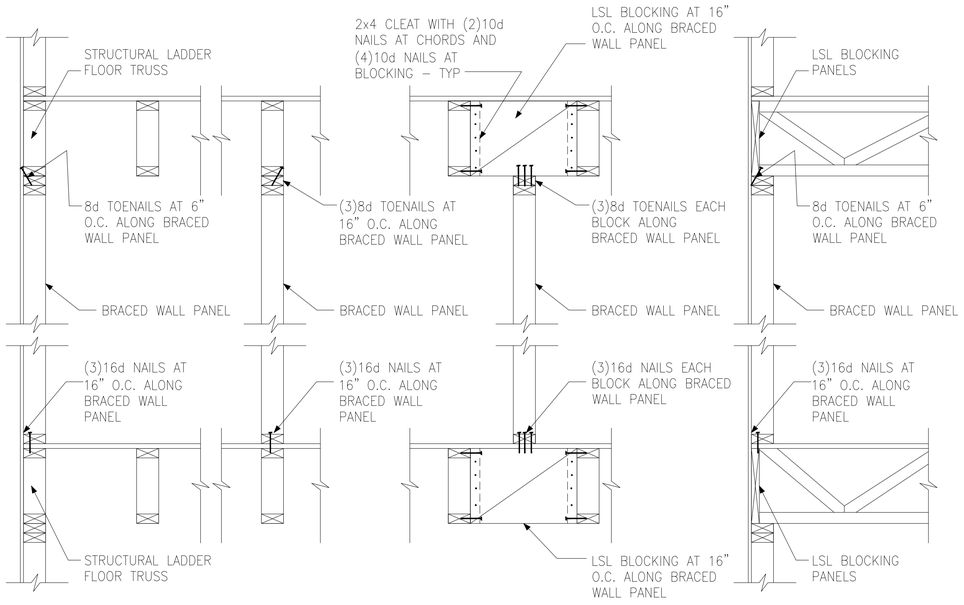
NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046496 ENGINEER ANDREW A. MOORE
3/9/23

Braced Wall Details

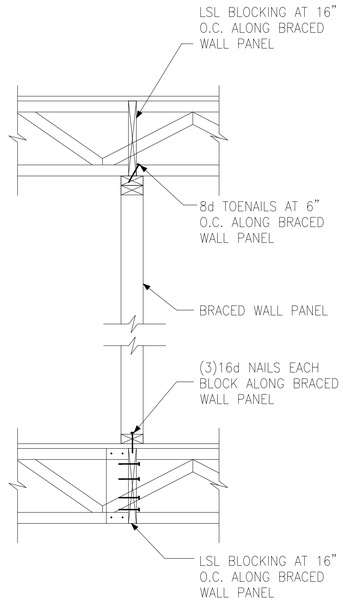
Up to 120 M.P.H.
Raleigh, North Carolina

Project #:	214-22000
Designed By:	KRK
Checked By:	
Issue Date:	3/6/23
Re-Issue:	
Scale:	1/8"=1'-0" @ 11x17 1/4"=1'-0" @ 22x34

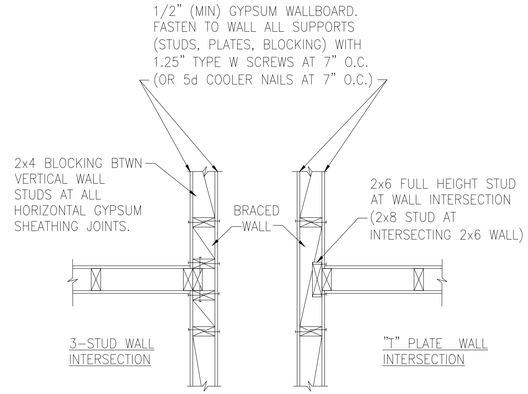
SD-1



A TYPICAL BRACED WALL PANEL TO FLOOR / CEILING CONNECTION
BRACED WALL PANELS PARALLEL TO TRUSSES

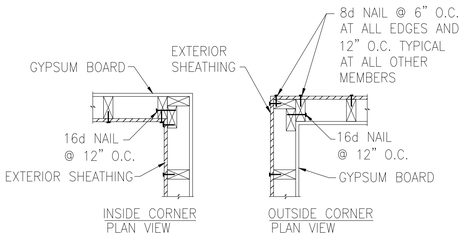


B TYPICAL BRACED WALL PANEL TO FLOOR / CEILING CONNECTION
BRACED WALL PANELS PERPENDICULAR TO TRUSSES

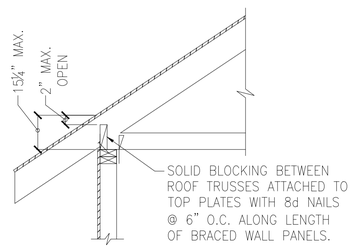


BRACED WALL INTERSECTIONS MAY BE FRAMED USING EITHER THE 3-STUD OR THE T-PLATE METHOD.

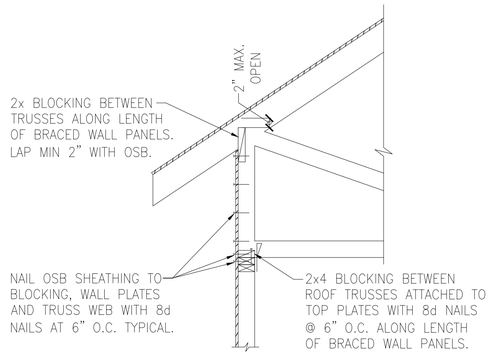
C METHOD GB(1) AND GB(2) INTERSECTION DETAILS



D TYPICAL EXTERIOR CORNER WALL FRAMING



HEEL HEIGHT GREATER THAN 9¼" AND LESS THAN 15¼"



HEEL HEIGHT GREATER 15"

E ROOF TRUSS BEARING/BLOCKING AT BRACED WALL PANELS
ONLY REQUIRED AT BRACED WALL PANELS

NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046496 ENGINEER ANDREW A. MOORE
3/9/23

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

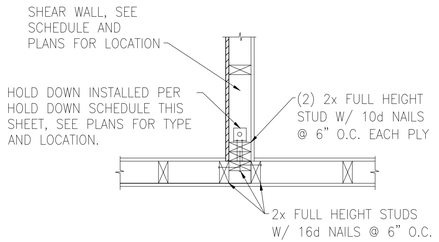
DAVIDSON HOMES

Braced Wall Details

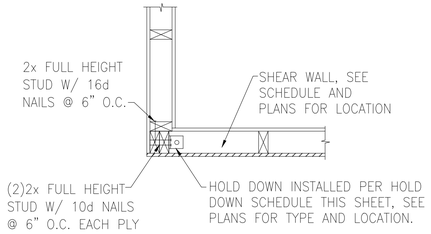
Up to 120 M.P.H.
Raleigh, North Carolina

Project #:	214-22000
Designed By:	KRK
Checked By:	
Issue Date:	3/6/23
Re-Issue:	
Scale:	1/8"=1'-0" @ 11x17 1/4"=1'-0" @ 22x34

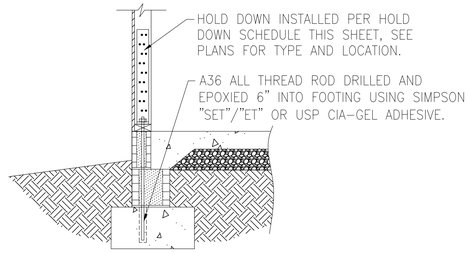
SD-1



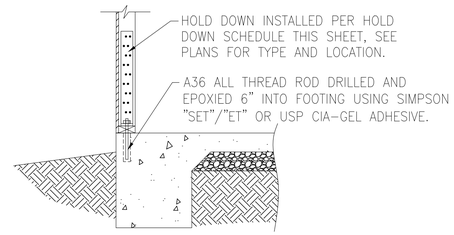
A TYPICAL HOLD DOWN DETAIL



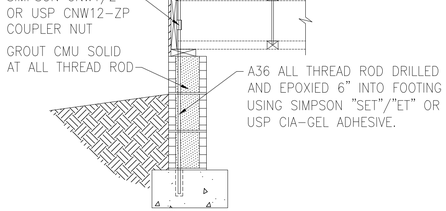
B TYPICAL HOLD DOWN DETAIL



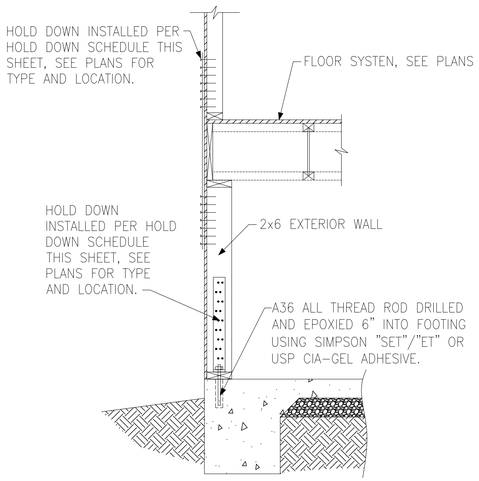
C HOLD DOWN AT STEMWALL SLAB FOUNDATION



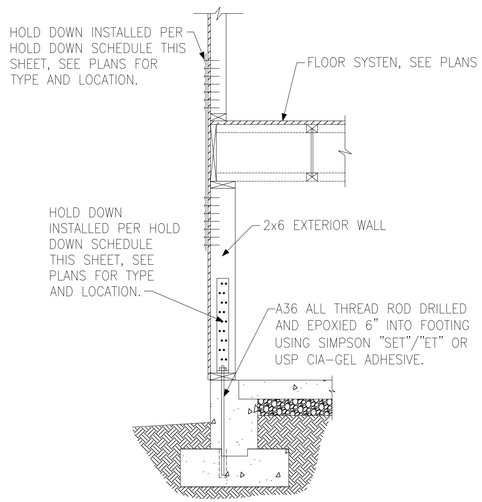
D HOLD DOWN AT MONOLITHIC SLAB FOUNDATION



E HOLD DOWN AT CRAWL SPACE FOUNDATION



F HOLD DOWN AT BASEMENT FOUNDATION
MONOLITHIC TURN-DOWN



G HOLD DOWN AT BASEMENT FOUNDATION
STEM WALL

HOLD DOWN SCHEDULE

HOLD DOWN		ALL THREAD ROD	FASTENERS
SIMPSON	USP		
LTTP2	LTS20B	½" DIA.	(12)0.148"x2.5" LONG NAILS
HTT4	HTT16	⅝" DIA.	(18)0.162"x2.5" LONG NAILS
HTT5	HTT45	⅝" DIA.	(26)0.162"x2.5" LONG NAILS

NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046986 ENGINEER ANDREW A. MOORE
3/9/23

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

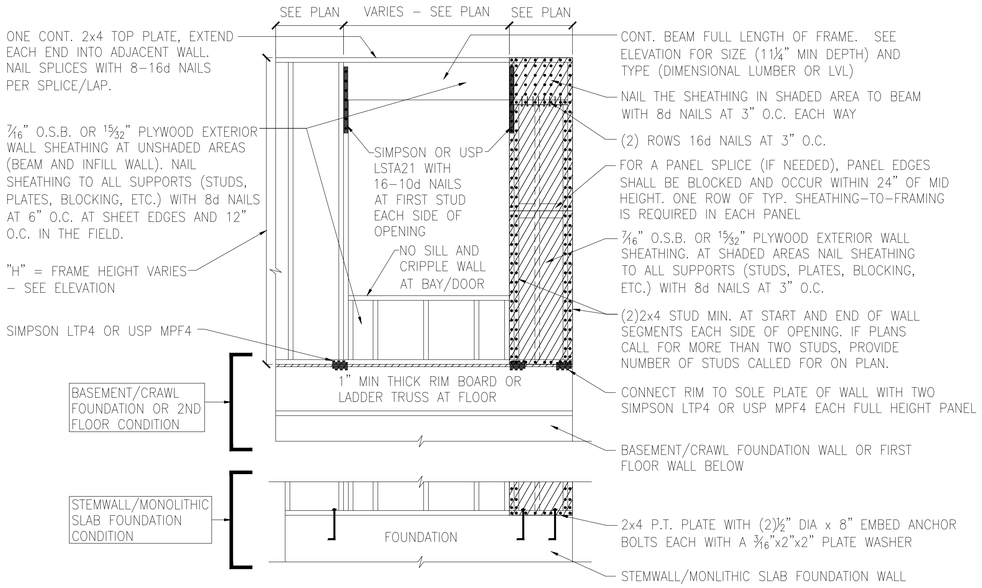
DAVIDSON HOMES

Hold Down Details

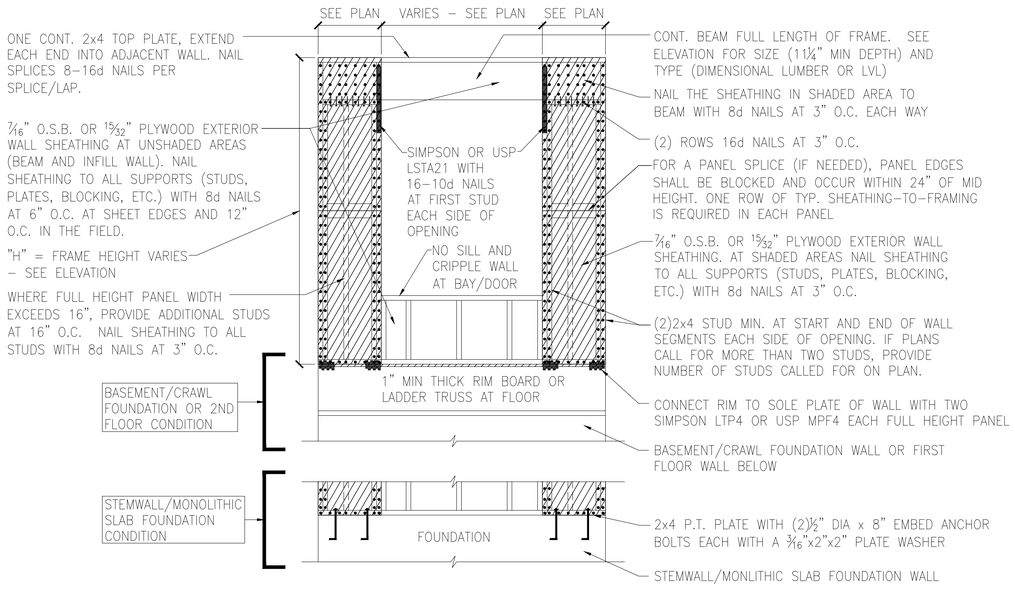
Up to 120 M.P.H.
Raleigh, North Carolina

Project #: 214-22000
Designed By: KRK
Checked By:
Issue Date: 3/6/23
Re-Issue:
Scale: 1/8"=1'-0" @ 11x17
1/4"=1'-0" @ 22x34

SD-2



A METHOD CS–PF: CONTINUOUS PORTAL FRAME PANEL CONSTRUCTION
ONE BRACED WALL SEGMENT



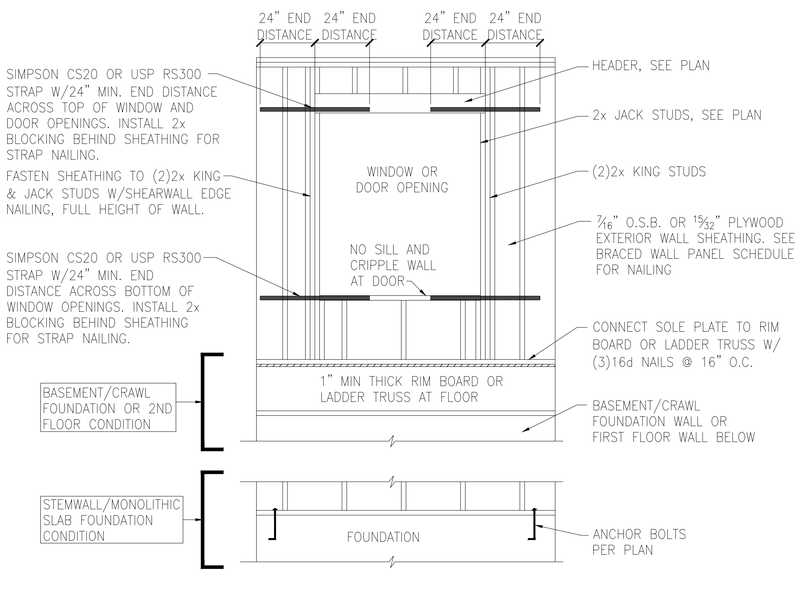
B METHOD CS–PF: CONTINUOUS PORTAL FRAME PANEL CONSTRUCTION
TWO BRACED WALL SEGMENTS

BRACED WALL PANEL AND ENGINEERED SHEAR WALL SCHEDULE

PANEL TYPES	PANEL TYPE	MATERIAL	FASTENERS
WSP	INTERMITTENT WOOD STRUCTURAL PANEL	7/16" OSB	6D OR 8D COMMON NAILS AT 6" O.C. AT SHEET EDGES AND 12" O.C. AT INTERMEDIATE SUPPORTS. ENGINEERED ALTERNATIVE: 16 GAGE BY 1.75" LONG STAPLES AT 3" O.C. AT SHEET EDGES AND 6" O.C. AT INTERMEDIATE SUPPORTS
GB(1)	INTERMITTENT GYPSUM BOARD (SHEATHING ONE FACE OF WALL)	1/2" GYPSUM	1.5" LONG GALV. ROOFING NAILS, 6d COMMON NAILS, OR 1.25" LONG TYPE W DRYWALL SCREWS AT 7" O.C. AT SHEET EDGES AND INTERMEDIATE SUPPORTS.
GB(1)–4	INTERMITTENT GYPSUM BOARD (SHEATHING ONE FACE OF WALL)	1/2" GYPSUM	1.5" LONG GALV. ROOFING NAILS, 6d COMMON NAILS, OR 1.25" LONG TYPE W DRYWALL SCREWS AT 4" O.C. AT SHEET EDGES AND INTERMEDIATE SUPPORTS.
GB(2)	INTERMITTENT GYPSUM BOARD (SHEATHING BOTH FACES OF WALL)	1/2" GYPSUM	1.5" LONG GALV. ROOFING NAILS, 6d COMMON NAILS, OR 1.25" LONG TYPE W DRYWALL SCREWS AT 7" O.C. AT SHEET EDGES AND INTERMEDIATE SUPPORTS.
CS–WSP	CONTINUOUS SHEATHED WOOD STRUCTURAL PANEL	7/16" OSB	6D OR 8D COMMON NAILS AT 6" O.C. AT SHEET EDGES AND 12" O.C. AT INTERMEDIATE SUPPORTS. ENGINEERED ALTERNATIVE: 16 GAGE BY 1.75" LONG STAPLES AT 3" O.C. AT SHEET EDGES AND 6" O.C. AT INTERMEDIATE SUPPORTS
CS–PF	CONTINUOUS SHEATHED PORTAL FRAME	7/16" OSB	NAILING PER DETAIL
PFH	PORTAL FRAME WITH HOLD DOWNS	7/16" OSB	NAILING PER DETAIL
CS–ESW(1)	ENGINEERED SHEAR WALL, TYPE 1	7/16" OSB	8D COMMON NAILS AT 6" O.C. AT SHEET EDGES AND 12" O.C. AT INTERMEDIATE SUPPORTS. CONTINUOUS OSB AROUND DOOR/WINDOW OPENINGS
CS–ESW(2)	ENGINEERED SHEAR WALL, TYPE 2	7/16" OSB	8D COMMON NAILS AT 4" O.C. AT SHEET EDGES AND 12" O.C. AT INTERMEDIATE SUPPORTS. CONTINUOUS OSB AROUND DOOR/WINDOW OPENINGS
CS–ESW(3)	ENGINEERED SHEAR WALL, TYPE 3	7/16" OSB	8D COMMON NAILS AT 3" O.C. AT SHEET EDGES AND 12" O.C. AT INTERMEDIATE SUPPORTS. CONTINUOUS OSB AROUND DOOR/WINDOW OPENINGS

BRACED WALL PANEL NOTES:

1. ALL BRACED WALL PANELS, EXCEPT GB(1) & GB(2), SHALL HAVE 2x BLOCKING BETWEEN WALL STUDS AT ALL HORIZONTAL SHEET EDGES.
2. PROVIDE NAILING/BLOCKING ABOVE AND BELOW ALL BRACED WALL PANELS PER KSE BRACED WALL DETAILS.
3. SHEATH ALL EXTERIOR WALLS OF THE HOUSE WITH 7/16" O.S.B., OR 15/32" PLYWOOD, FASTENED PER IRC. AT EXTERIOR CORNERS, SHEATHING SHALL BE FASTENED PER KSE BRACED WALL DETAILS. AT INTERIOR WALL INTERSECTIONS, FASTEN STUDS & WALL BRACING PER KSE BRACED WALL DETAILS.
4. BRACED WALL PANELS AND ENGINEERED SHEAR WALLS ARE PROVIDED PER IRC. PANEL LENGTHS SHOWN ON PLANS ARE THE MINIMUM LENGTH REQUIRED.



C WINDOW OR DOOR REINFORCEMENT IN ENGINEERED SHEAR WALL
ONLY REQUIRED WHERE SPECIFED ON PLANS

NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046996 ENGINEER ANDREW A. MOORE
3/9/23

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

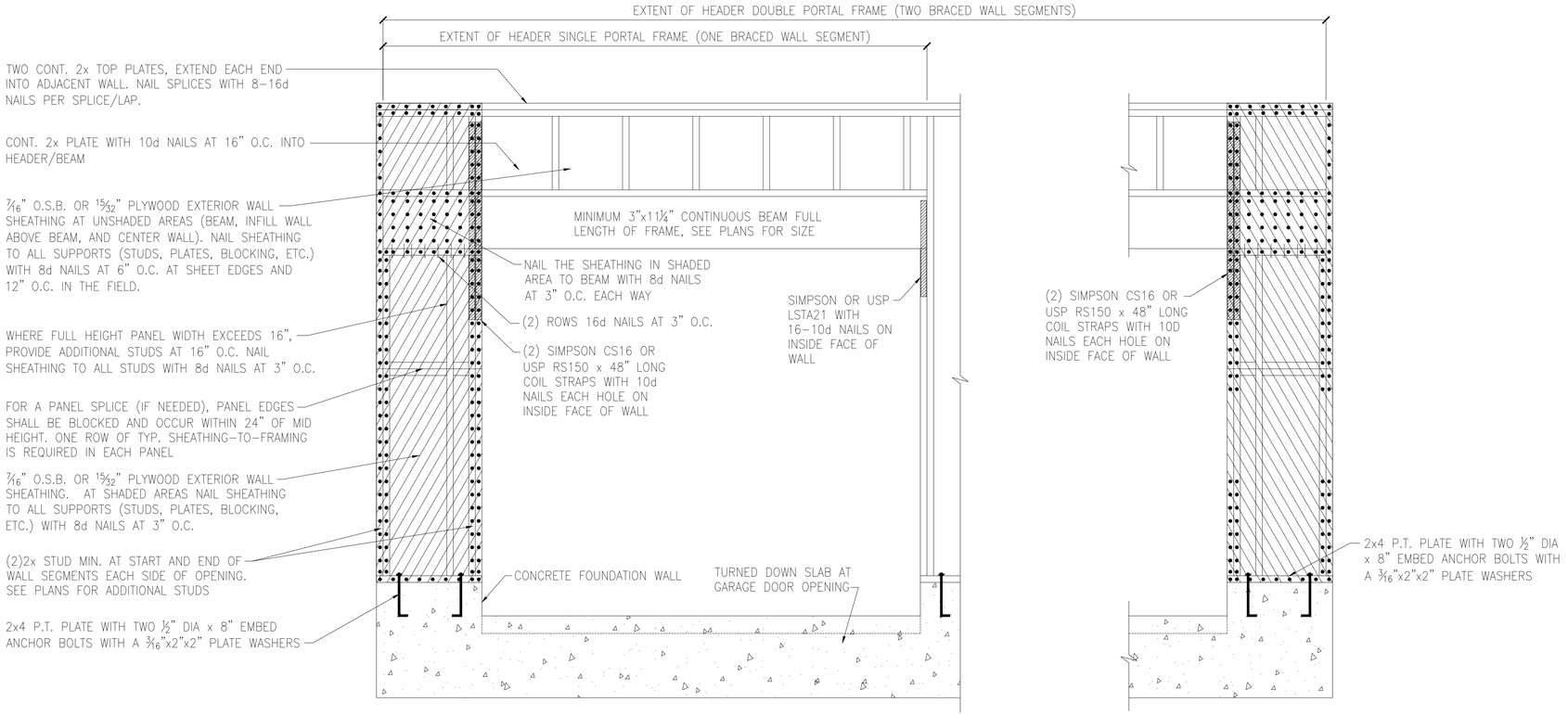
DAVIDSON HOMES

Braced Wall Notes & Details

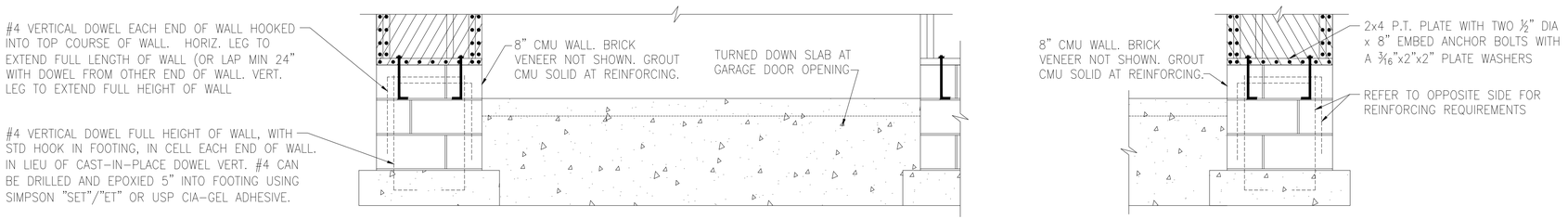
Up to 120 M.P.H.
Raleigh, North Carolina

Project #:	214–22000
Designed By:	KRK
Checked By:	
Issue Date:	3/6/23
Re–Issue:	
Scale:	1/8"=1'–0" @ 11x17 1/4"=1'–0" @ 22x34

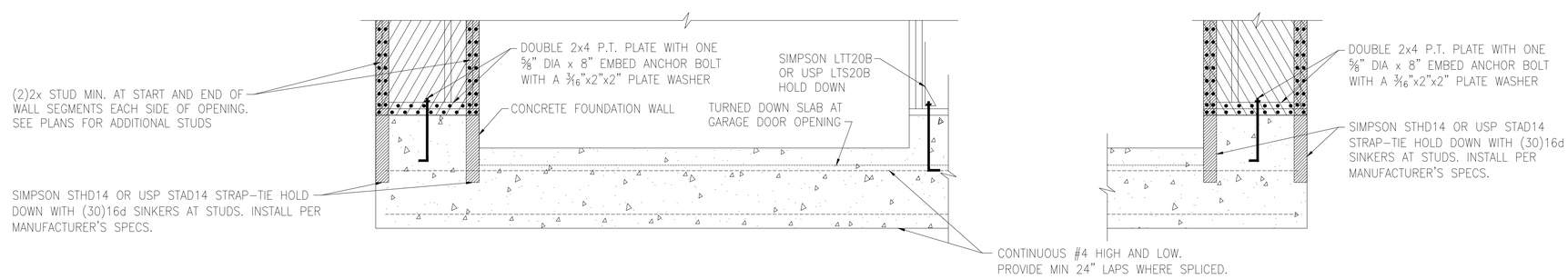
SD–3



A METHOD CS-PF: CONTINUOUS PORTAL FRAME PANEL CONSTRUCTION
MONOLITHIC SLAB OR BASEMENT FOUNDATION



B METHOD CS-PF: CONTINUOUS PORTAL FRAME PANEL CONSTRUCTION
STEMWALL SLAB OR CRAWL SPACE FOUNDATION



C METHOD PFH: PORTAL FRAME WITH HOLD-DOWNS
MONOLITHIC SLAB OR BASEMENT FOUNDATION

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

DAVIDSON HOMES

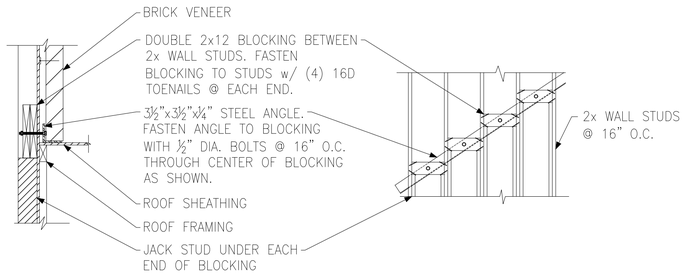
Portal Frame Details

Up to 120 M.P.H.
Raleigh, North Carolina

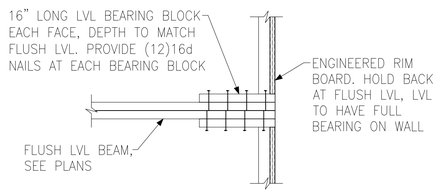
Project #:	214-22000
Designed By:	KRK
Checked By:	
Issue Date:	3/6/23
Re-Issue:	
Scale:	1/8"=1'-0" @ 11x17 1/4"=1'-0" @ 22x34

SD-4

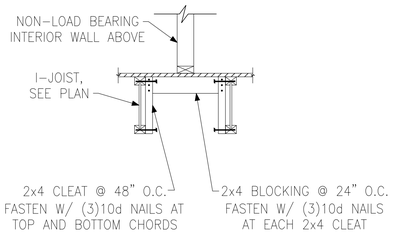
NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046496 ENGINEER ANDREW A. MOORE
3/9/23



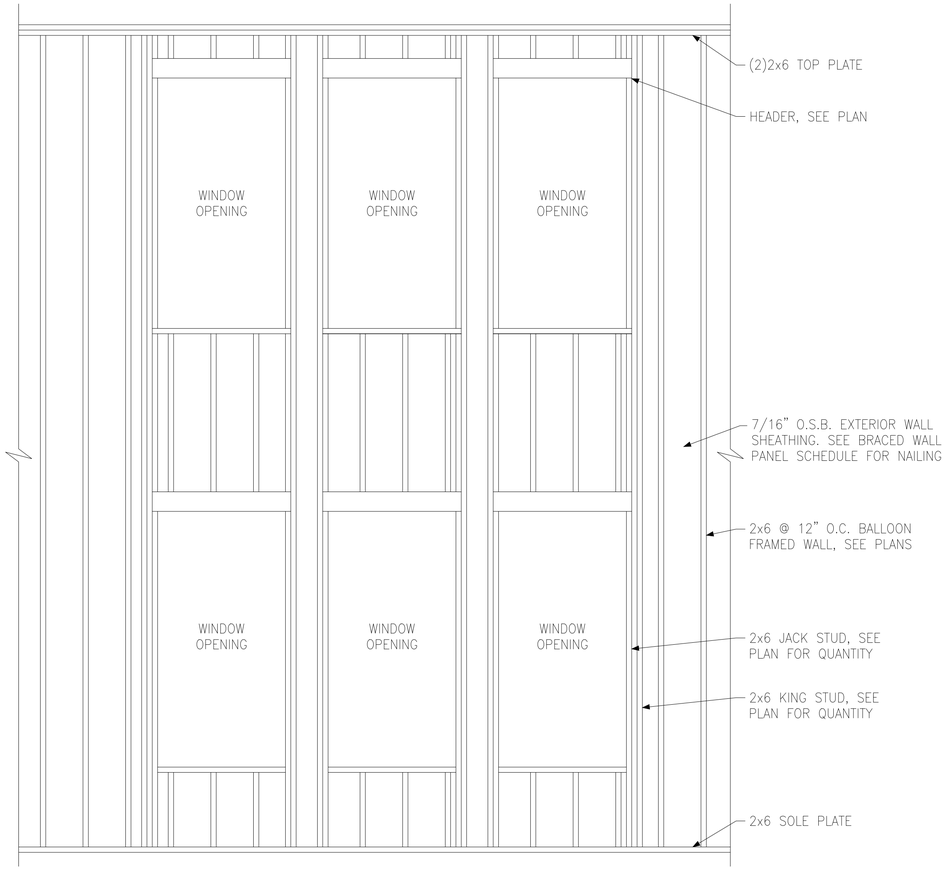
A BRICK LEDGER CONNECTION DETAIL



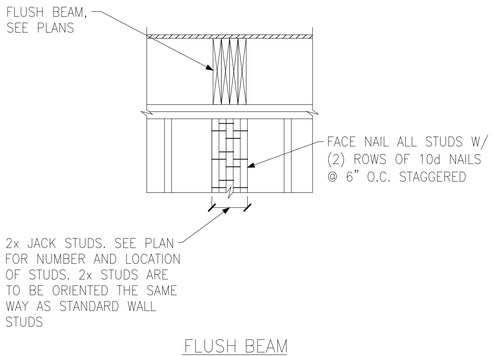
B BEARING ENHANCER
FLUSH LVL

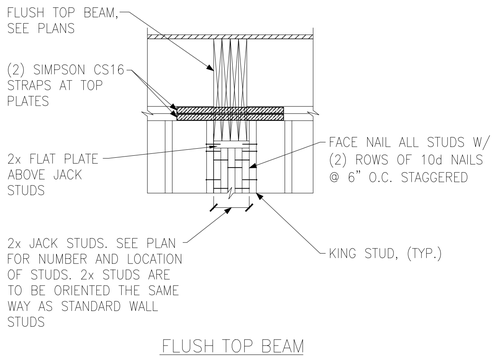


C I-JOIST LADDER BLOCKING
AS REQUIRED @ PARALLEL WALLS



D BALLOON FRAMED WALL DETAIL
N.T.S.





E BUILT-UP STUD DETAIL SUPPORTING BEAM

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

DAVIDSON HOMES

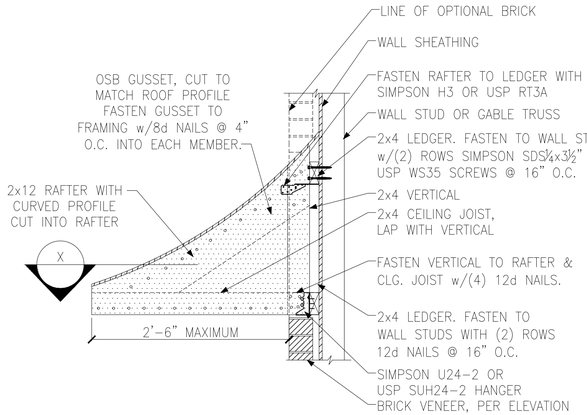
Miscellaneous Framing Details

Up to 120 M.P.H.
Raleigh, North Carolina

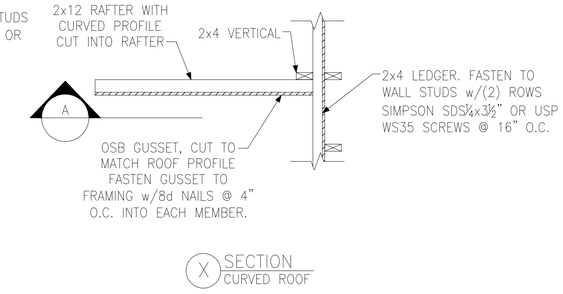
Project #:	214-22000
Designed By:	KRK
Checked By:	
Issue Date:	3/6/23
Re-Issue:	
Scale:	1/8"=1'-0" @ 11x17 1/4"=1'-0" @ 22x34

NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046996 ENGINEER ANDREW A. MOORE
3/9/23

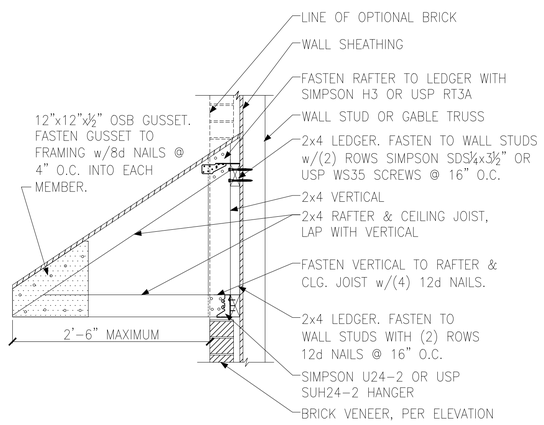
SD-5



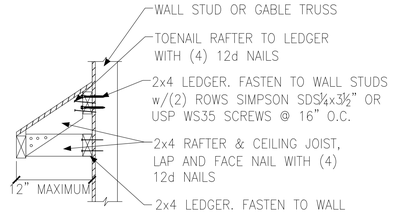
A PENT ROOF DETAIL
CURVED ROOF



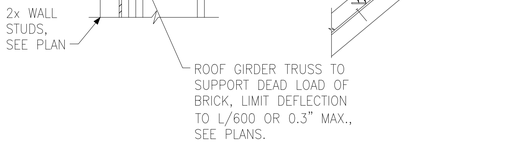
X SECTION
CURVED ROOF



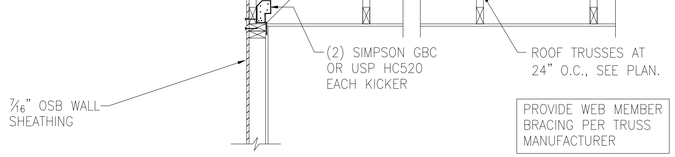
B PENT ROOF DETAIL
STRAIGHT ROOF



C EYEBROW ROOF DETAIL
STRAIGHT ROOF



D TRUSS DETAIL



E GABLE END WALL DETAIL

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

DAVIDSON HOMES

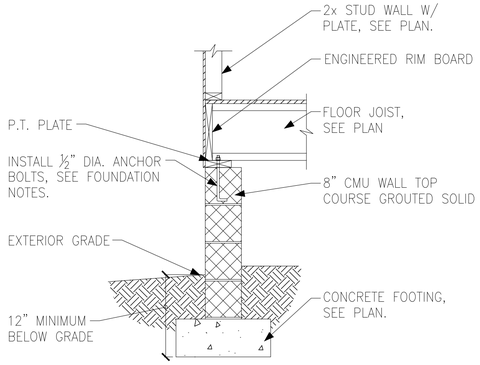
NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 046986 ANDREW A. MOORE
3/9/23

Miscellaneous Framing Details

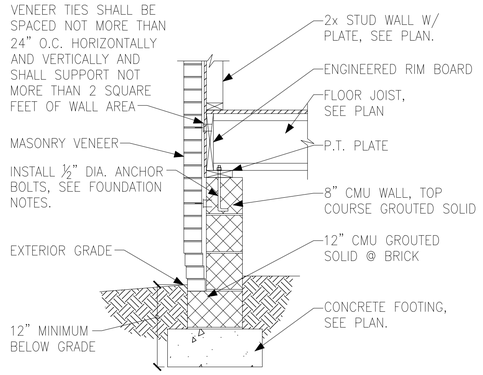
Up to 120 M.P.H.
Raleigh, North Carolina

Project #:	214-22000
Designed By:	KRK
Checked By:	
Issue Date:	3/6/23
Re-Issue:	
Scale:	1/8"=1'-0" @ 11x17 1/4"=1'-0" @ 22x34

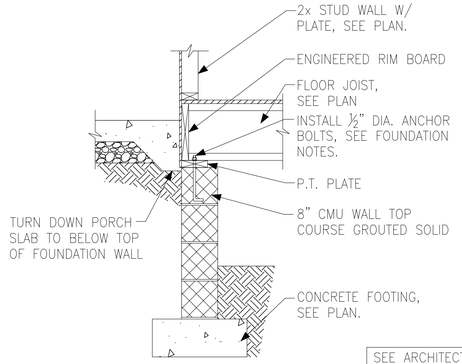
SD-6



A FOUNDATION SECTION
EXTERIOR WALL

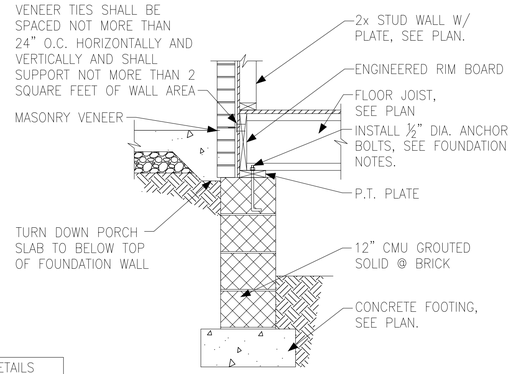


B FOUNDATION SECTION
EXTERIOR WALL @ MASONRY VENEER



C FOUNDATION SECTION
EXTERIOR WALL AT PORCH

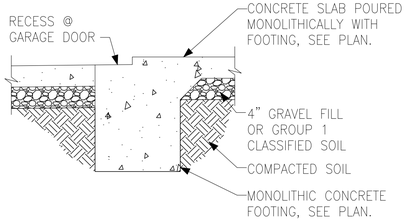
SEE ARCHITECTURAL DETAILS FOR WATERPROOFING AT PORCH SLAB/WOOD FRAMING.



D FOUNDATION SECTION
EXTERIOR WALL AT PORCH W/ MASONRY VENEER

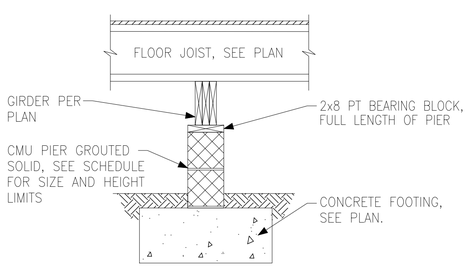
E FOUNDATION SECTION
EXTERIOR GARAGE WALL

F FOUNDATION SECTION
EXTERIOR GARAGE WALL @ MASONRY VENEER

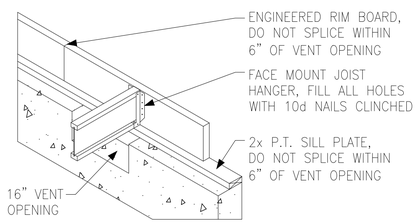


G FOUNDATION SECTION
GARAGE DOOR

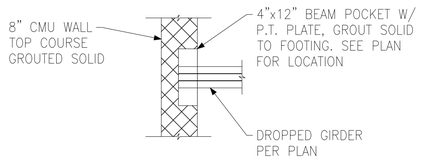
H FOUNDATION SECTION
INTERIOR GARAGE WALL



J FOUNDATION SECTION
INTERIOR PIER



K CRAWL SPACE VENT DETAIL



L CRAWL SPACE BEAM POCKET DETAIL

PIER AND FOOTING SCHEDULE

PIER HEIGHT	PIER SIZE	MIN. FOOTING SIZE
UP TO 2'-8"	8" x 16"	24" x 24" x 12" U.N.O.
UP TO 5'-4"	16" x 16"	24" x 24" x 12" U.N.O.
UP TO 8'-0"	16" x 16"	30" x 30" x 12" U.N.O.

NOTE:
PIERS SHALL BE CAPPED WITH 8" OF SOLID MASONRY OR CONCRETE OR TOP COURSE FILLED SOLID WITH CONCRETE/MORTAR.
PIERS OVER 5'-4" SHALL BE BE FILLED SOLIDLY WITH CONCRETE OR TYPE M OR S MORTAR.
FOR PIERS OVER 8'-0" CONTACT KSE ENGINEERING FOR PIER AND FOOTING DESIGN.

NC Firm #C-2101
NORTH CAROLINA PROFESSIONAL SEAL 046496 ENGINEER ANDREW A. MOORE
3/9/23

KSE ENGINEERING
1900 AM DRIVE, SUITE 201, QUAKERTOWN, PA 18951
(215) 804-4449
www.kse-eng.com

DAVIDSON HOMES

Crawl Space Foundation Details

Up to 120 M.P.H.
Raleigh, North Carolina

Project #: 214-22000
Designed By: KRK
Checked By:
Issue Date: 3/6/23
Re-Issue:
Scale: 1/8"=1'-0" @ 11x17
1/4"=1'-0" @ 22x34

SD-9