CITY OF WEST LAKE HILLS, TEXAS
NOTICE OF CITY COUNCIL REGULAR MEETING
Wednesday, April 8, 2026 at 7:00 PM

Notice is hereby given that the City Council of the City of West Lake Hills, Texas, will hold a Regular Meeting on the 8th day of April 2026 at 7:00 p.m., in the Council Chambers, Municipal Building, 4010 Bee Cave Road, West Lake Hills, Texas, at which time the following items will be discussed, to-wit:

REMOTE ACCESS - Join Zoom Meeting at https://us02web.zoom.us/j/3499549035
Or via telephone: Dial (346) 248-7799 - Meeting ID: 349 954 9035

If you wish to speak during the meeting or provide written comments, please email your name, phone number, comments, and the item number you wish to speak/comment on to citysec@westlakehills.gov by 1:00 P.M. on April 8, 2026.

1. Call to Order

2. Citizen Communications The City Council welcomes public comments at this point on any issue. If the issue is listed on the agenda, the speaker may choose to comment during the Public Comment period or when the specific agenda item is taken up by the Council later in the meeting. The Council cannot respond to or discuss matters not listed on the agenda. The Council may provide factual information, refer the item to a staff member, or request the item be added to a future meeting agenda. Speakers shall limit their comments to five (5) minutes each.

3. Consent Agenda All Consent Agenda items listed are considered to be routine by the City Council and will be enacted by one (1) motion. No separate discussion or action on any of the items is necessary unless requested by a Council Member.

    a. Approval of the March 25, 2026 Regular Meeting Minutes.
    b. Approval of the April 1, 2026 Workshop Minutes.

4. Administration Discuss and consider action to approve the budget calendar for Fiscal Year 2026-27

5. Public Hearing **300 Block of Laurel Valley Rd**: Discuss and consider action on a recommendation from ZAPCO on a proposed variance to allow replacement trees for unpermitted removals to be planted at the end of the project, more than 601 days since final order (Section 22.03.304(c)(5) of the West Lake Hills Code).

   Applicant: Matt Garcia, Matt Garcia Design

6. Public Hearing **419 Ridgewood Rd**: Discuss and take action on a recommendation from ZAPCO regarding proposed variances for the removal of one tree (14.25 inch elm) with trunk diameters of 14 inches or greater, (Section 22.03.304 of the West Lake Hills Code).

   Applicant: Nina Falgout Sterrett, Arterberry Cooke Architecture

7. Public Hearing Discuss and consider action to adopt Ordinance 2026-003 to amend the Drainage and Erosion Control Design Manual.

8. Administration Discuss code amendments related to Chapters 1, 20, 22, 32, 36, and 38 of the City Code.

9. Adjournment

Approved by: James Vaughan, Mayor

Certificate

I certify that the above Notice of the April 8, 2026 City Council Regular Meeting was posted on the bulletin board at the Municipal Building, 4010 Bee Cave Road, West Lake Hills, Texas on Wednesday, April 1, 2026 by 5:00 pm. and will remain posted continuously until said meeting is convened.

Signed by: Makayla Rodriguez, City Secretary

The City of West Lake Hills is committed to compliance with the Americans with Disabilities Act. Reasonable accommodation and equal access to communications will be provided upon request.

All items on the agenda are for discussion and/or action. City Council reserves the right to adjourn into executive session at any time during the course of this meeting to discuss any of the matters listed above, as authorized by Texas Government Code Sections 551.071 (Consultation with Attorney), 551.072 (Deliberations about Real Property), 551.073 (Deliberations about Gifts and Donations), 551.074 (Personnel Matters), 551.076 (Deliberations about Security Devices), and 551.086 (Economic Development).

CITY OF WEST LAKE HILLS, TEXAS
CITY COUNCIL REGULAR MEETING MINUTES
Wednesday, March 25, 2026 at 7:00 PM

1. Call to Order

With a quorum present, Mayor James Vaughan called the meeting to order at 7:00 p.m.

CITY COUNCIL PRESENT: Mayor James Vaughan, Mayor Pro Tem Gordon Bowman, Councilmember Dana Harmon, Councilmember Beth South, Councilmember Brian Plunkett, and Councilmember Darin Walker.

CITY STAFF PRESENT: City Administrator Trey Fletcher, City Secretary Makayla Rodriguez, Director of Building and Development Services Jennifer Bills, Finance Director Vonda Ragsdale, Public Works Director Evan Groeschel, Wastewater Accounting Manager Theresa Sanchez, Police Chief Scott Gerdes, and City Attorney Charles Zech.

2. Citizen Communications The City Council welcomes public comments at this point on any issue. If the issue is listed on the agenda, the speaker may choose to comment during the Public Comment period or when the specific agenda item is taken up by the Council later in the meeting. The Council cannot respond to or discuss matters not listed on the agenda. The Council may provide factual information, refer the item to a staff member, or request the item be added to a future meeting agenda. Speakers shall limit their comments to five (5) minutes each.

Mayor James Vaughan opened the meeting for public comment. Hearing none, the public comment section was closed.

3. Consent Agenda All Consent Agenda items listed are considered to be routine by the City Council and will be enacted by one (1) motion. No separate discussion or action on any of the items is necessary unless requested by a Council Member.

    a. Approval of the March 11, 2026 Regular Meeting Minutes.
    b. Discuss and consider action on a resolution to suspend Texas Gas Service (TGS) Company's interim rate increase effective May 9, 2026.

MOTION: Upon a motion made by Councilmember Beth South and seconded by Councilmember Darin Walker, the City Council voted 5-0 to approve the Consent Agenda.

4. Administration Presentation regarding Travis County Community Development Block Grant Program overview.

   Mikaela Manion of Travis County Community Development Block Program discussed details of the program including previously funded projects, federal grant programs, eligibility requirements, and a community needs survey.

   There was discussion regarding eligibility, income requirements, funding capacity, and program details.

5. Finance Discuss and consider acceptance of the FY 2024-25 Financial Audit.

   April Charlebois of Singleton Clark & Company - CPA's presented the annual finance report for Fiscal Year 2024-2025. She gave an overview of the general fund, fund balance, and summary of results.

   Mayor James Vaughan asked questions regarding the wastewater fund and City Council revenue bonds. Councilmember Brian Plunkett thanked Finance Director Vonda Ragsdale for her work on the audit.

   MOTION: Upon a motion made by Mayor Pro Tem Gordan Bowman and seconded by Councilmember Brian Plunkett, the City Council voted 5-0 to approve the audit.

6. Administration Discuss and consider wastewater capacity report and related land use assumptions.

   Leigh Thomas of HRGreen presented a map of the City's service area illustrating existing and projected wastewater flows. There was discussion regarding wastewater infrastructure needs and potential future land use in relation to finalizing the City's needs for the wholesale agreement with the City of Austin.

   City Council and Ms. Thomas discussed timeframes, infrastructure capacity, and grinder pump systems. Mayor James Vaughan expressed support for the 10–15-year plan assumption. Councilmember Dana Harmon stated that she was also in support of the assumption.

   MOTION: Upon a motion made by Councilmember Dana Harmon and seconded by Councilmember Darin Walker, the City Council voted 5-0 to accept the existing and projected wastewater flows as a basepoint and move forward with discussion with the City of Austin.

7. Administration Receive an update and consider possible action regarding City of West Lake Hills v. Jaffe - 1405 Wildcat Hollow.

   Director of Building and Development Services Jennifer Bills stated that she continues to have site visits with the Contractor and that they are exploring minor site changes.

8. Adjournment

Mayor James Vaughan adjourned the meeting at 8:24 p.m.

Respectfully submitted:

_____
James Vaughan, Mayor

ATTEST:

_____
City Secretary, Makayla Rodriguez

The minutes were approved on the 8th of April, 2026.

CITY OF WEST LAKE HILLS, TEXAS
CITY COUNCIL WORKSHOP MINUTES
Wednesday, April 1, 2026 at 12:00 PM

1. Call to Order

   With a quorum present, Mayor James Vaughan called the meeting to order at 12:07 p.m.

   CITY COUNCIL PRESENT: Mayor James Vaughan, Mayor Pro Tem Gordon Bowman, Councilmember Dana Harmon, Councilmember Beth South, Councilmember Brian Plunkett. Councilmember Darin Walker was not in attendance.

   CITY STAFF PRESENT: City Administrator Trey Fletcher, City Secretary Makayla Rodriguez, Director of Building and Development Services Jennifer Bills, Public Works Director Evan Groeschel, Police Chief Scott Gerdes, and City Attorney Esther Peña.

2. Citizen Communications The City Council welcomes public comments at this point on any issue. If the issue is listed on the agenda, the speaker may choose to comment during the Public Comment period or when the specific agenda item is taken up by the Council later in the meeting. The Council cannot respond to or discuss matters not listed on the agenda. The Council may provide factual information, refer the item to a staff member, or request the item be added to a future meeting agenda. Speakers shall limit their comments to five (5) minutes each.

   Mayor James Vaughan opened the meeting for public comment. Hearing none, the public comment section was closed.

3. Administration Discuss the City of West Lake Hills Strategic Plan (2025-2027) and updates to Strategic Focus Area 6: Strengthen Regional Partnerships and Collaboration.

   Mayor James Vaughan briefed City Council on updates to the MoPac South Expansion Project. He reported that the Central Texas Regional Mobility Authority (CTRMA) has proposed changes to improve access to the northbound express lane. There was discussion regarding access to the City, impacts on traffic, and changes in travel time.

4. Staff Briefing Discuss code amendments related to the city's drainage and erosion control manual.

   Director of Building and Development Services Jennifer Bills briefed City Council on amendments to the drainage and erosion control manual. City Council and staff discussed current processes, drainage criteria, lot impacts, applicability, and materials.

5. Staff Briefing Discuss code amendments related to Chapters 1, 22, and 38 of the City Code.

   Mayor James Vaughan moved to item 7.

   Mayor James Vaughan discussed need for amendments to reduce discrepancies within the Code of Ordinances, noting that frequent variance requests indicate a need to update and refine the code. Director of Building and Development Services Jennifer Bills briefed City Council on clarifying amendments, building setbacks, pools, and impacts to lots.

6. Staff Briefing Discuss budget amendments to support code restructuring, AI enabled traffic signals, North Peak street and drainage improvements, and tree ordinances provisions.

   This item was not discussed.

7. Staff Briefing Discuss construction parking fees at 911 Westlake Drive.

   Mayor James Vaughan informed City Council that construction was underway at East Basin Ledge and that he allowed excess vehicles to park at 911 Westlake Drive during the project by purchasing temporary parking permits from the City to accommodate overflow parking.

   MOTION: Upon a motion made by Councilmember Dana Harmon and seconded by Mayor Pro Tem Gordon Bowman, the City Council voted 4-0 to allow passenger vehicles to park in front of the old City Hall for $15 per day or $200 per month.

   Mayor James Vaughan moved to item 5.

8. Adjournment

   Mayor James Vaughan adjourned the meeting at 2:07 p.m.

Respectfully submitted:

_____

James Vaughan, Mayor

ATTEST:

_____
City Secretary, Makayla Rodriguez

The minutes were approved on the 8th day of April, 2026.

Budget Process and Schedule for Fiscal Year 2026-2027

April 8th – Regular City Council Meeting

- Mayor presents Proposed FY 2026-27 Budget Calendar to Council.
- Council adopts Budget Calendar.

June 2nd – Department Meetings

- Administration Department
- Wastewater

June 4th – Department Meetings

- Police Department & PD Special Revenue Fund
- Municipal Court & Court Special Revenue Fund

June 5th – Department Meetings

- Planning & Development
- Public Works, Facilities M&O, Street Maintenance & Tree Fund

June 10th – Mayor Meeting

- Meeting with Mayor with Department Requests – Preliminary Budget

June 17th – Mayor Meeting

- 2nd Meeting with Mayor– Preliminary Budget (if needed)

July 8th – Regular City Council Meeting

- Mayor presents Proposed FY2026-27 Budget to Council.
- Presentation of First Budget Group: Administration, Municipal Court, and Wastewater.

July 22nd – Regular City Council Meeting

- Continue discussing Proposed Budget.
- Presentation of Second Budget Group: Police Department, Planning & Development, Public Works, and Discretionary Items.

July 25th – Travis County Appraisal District

- Deadline for Chief Appraiser to send estimated appraisal rolls to jurisdictions.

August 7th – POST calculated tax rates along with certain debt information on City website homepage

August 12th – Regular City Council Meeting

- Continue FY 2026-27 Proposed Budget discussion.
- Council to approve the Certified Appraisal Roll and approve the proposed Ad Valorem Tax Rate for Debt Service for the FY 2026-27 Budget.

August 17th – File Proposed Budget with the Municipal Clerk and POST on City website homepage

- *(Must be filed at least 30 days before tax rate adopted)*

August 26th – Regular City Council Meeting

- Continue discussing Proposed Budget.

August 29th – PUBLISH Public Hearing Notice

- PUBLISH public hearing on proposed property tax rate and budget in newspaper.
  - *(Must be published at least 10 days before Public Hearing)*
  - *(May NOT be in the part of the paper in which legal notices and classified ads appear)*
- POST public hearing notice on the City website homepage.

September 9th – Regular City Council Meeting

- Budget & Property Tax Rate Public Hearing.
  - *(Must be at least 15 days after proposed budget filed with Municipal Clerk)*

- *(Public Hearing on budget shall be before the date of the tax levy)*

- Council vote to postpone the final vote on budget to a specific date and time.
- Continue FY 2026-27 Proposed Budget discussion.
- FY 2025-26 Budget Amendment discussion.

September 16th – Special Called City Council Meeting

- *(Either at the Public Hearing or no later than 7th day after the Public Hearing)*

- Council adopts FY 2026-27 Budget (*ordinance*).
- Council ratifies the property tax revenue increase reflected in the budget (*ordinance*).
- Council adopts property tax rate (*ordinance*).
- Council approves the General Fund Balance Policy (*resolution*).
- Council approves the Investment Policy & Strategy and the Financial Procedures & Controls

October – Regular City Council Meeting

- Council adopts Amended FY 2025-26 Budget (*ordinance*).

*** NOTE: Except if a tax rate is adopted that exceeds the voter-approval tax rate, not later than the 71st day before the next uniform election date in November of that year (August 24th) – In this instance, the calendar would need to be modified to satisfy the compacted timeline.*

City *of* West Lake Hills
City Council

AGENDA REPORT

Meeting Date:	April 8, 2026	**Item Number:**	5
Department:	Building & Development		
Prepared By:	Jennifer C. Bills	**Cost / Budget:**	None
Exhibits:	See Attached	**Source of Funds:**	N/A

Subject

300 Block of Laurel Valley Rd.: Discuss and consider action on a recommendation from ZAPCO on a proposed variance to allow replacement trees for unpermitted removals to be planted at the end of the project, more than 601 days since the final order (Section 22.03.304(c)(5).

Applicant: Matt Garcia, Matt Garcia Design

Recommendation

Hold a public hearing and determine the following findings of fact to approve or deny the requested variances.

1. The strict or literal enforcement of the terms of this chapter, because of special conditions, will result in unnecessary hardship to the applicant.
2. There will not be unreasonable disruption of the natural terrain or unreasonable destruction of existing flora.
3. There is no reasonable alternative to the requisite variance that will alleviate the difficulty or hardship complained of.
4. The variance will not be greater than the minimum required to alleviate the difficulty or hardship complained of.

The findings of fact as alleged by the applicant are attached in Exhibit A.

1. The variance may violate the intent of this chapter or the goals of the city's comprehensive plan.
2. The variance may have an adverse effect on neighborhood properties or interfere with the respective owners' enjoyment thereof.

The City Council can recommend imposition of reasonable conditions upon granting a variance if the conditions are related to the subject of the variance.

This item was reviewed by the Zoning and Planning Commission on February 18, 2026 and the following criteria used:

1. The variance may violate the intent of this chapter or the goals of the city's comprehensive plan; and
2. The variance may have an adverse effect on neighborhood properties or interfere with the respective owners' enjoyment thereof.

ZAPCO recommended **denial** of the variance 5-0 due to lack of hardship. (Attachment 3)

Discussion

Property Information, Zoning & Site Characteristics:
Owner: Graham Schmergel
Legal Description: Yaupon Valley Subdivision, Lot 8
Lot Size: 0.4371 acres
Zoning: R-1 One Family
Wastewater: On-site Sewage Facility (Septic)

The properties surrounding the subject property are zoned R-1, One Family Residential.

Background:
The applicant is proposing to build a new 4,320 sf house (Attachment 1). The site is 0.4371 acres in size, which was platted in 1962. The total impervious cover in the concept plan is 4,524 sf (23.3%). The property was issued a permit for new residential construction on March 12, 2022. The house was never started, however during site preparation, trees were illegally removed. Through the municipal court deferred adjudication, the owner was required to submit a plan for 408 caliper inches planted on site, to be completed with the previous permit. The tree plan was approved June 12, 2023. Due to more than six months of inactivity, the permit was marked as expired October 24, 2024. It has been more than 900 days since the final order in June 2023.

Analysis:
Violation of removal procedure

Code Requirements

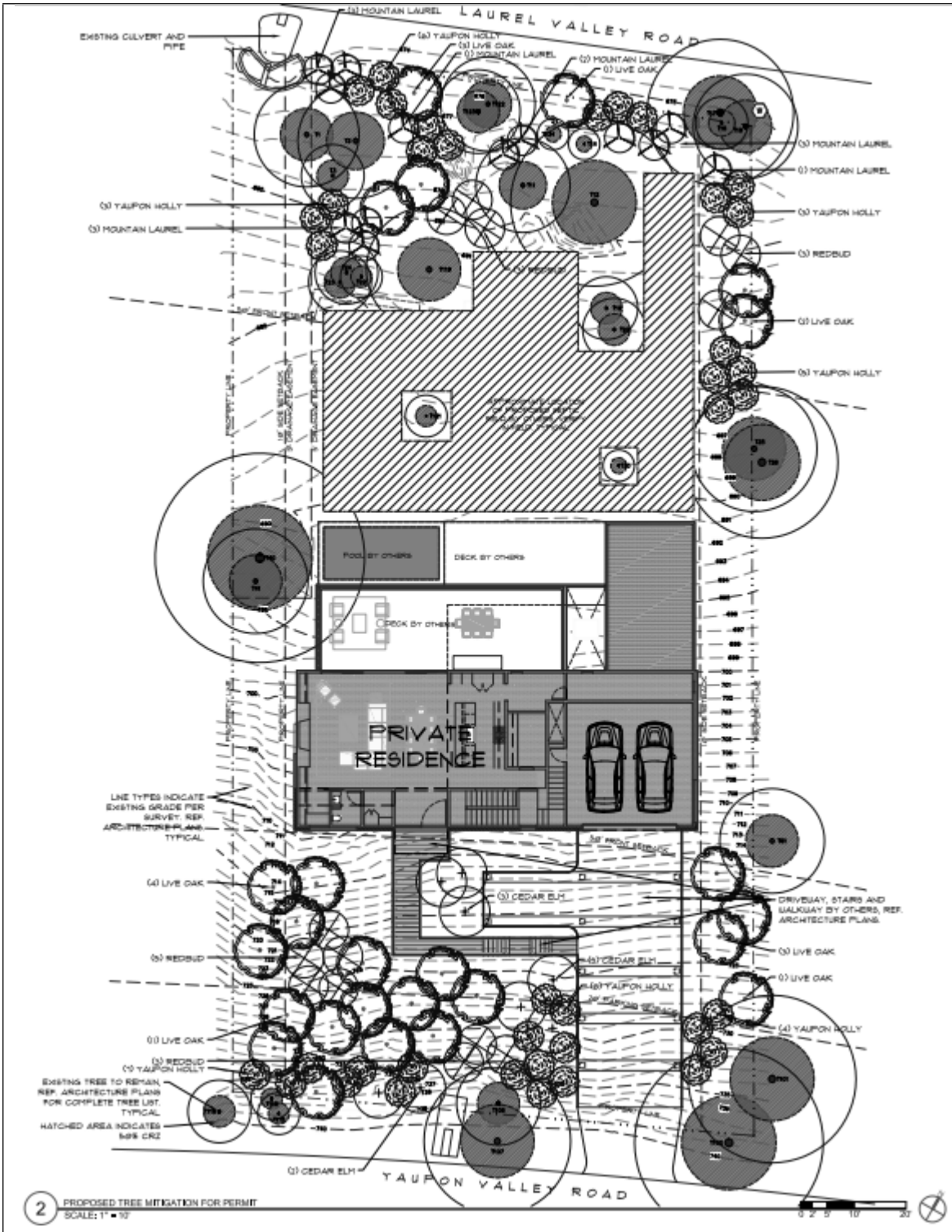
- **Section 22.03.304. Tree and vegetation removal and replacement.**

(c) Violation of removal procedure

(5) It is a separate offense to fail to replace trees or vegetation, or remit to the city cash-in-lieu, as provided in this code, within 601 days of issuance of a final order by the city.

Request

- To delay planting trees to an undetermined time at the end of the building project.



Proposed Tree Mitigation Plan (Attachment 4)

Public Comment:

As of the date of the report, three written comments have been received in opposition (Attachment 5).

Variance Criteria Review:

Trees follow the procedure and notice found in Section 22.03.511 Procedure and notice:

(a) The city council, when petitioned for a variance, after 16 days' written notice to all property owners within 300 feet of the subject property, shall hold a hearing, and the city council may vary the application of any

provision of this article to any particular case when, in its opinion, the enforcement thereof would do manifest injustice, and would be contrary to the spirit and purpose of this article or public interest, or when, in its opinion, the interpretation and recommendation of the zoning and planning commission should be modified or reversed.

(b) A decision of the city council to vary the application of any provision of this article shall specify in what manner such variance is made, the conditions upon which it is made and the reasons thereof.

The criteria and process for granting a variance found in Section 22.03.514:

No variance shall be granted under this chapter unless the following criteria are fulfilled:

- Findings. The applicant has established by competent evidence that:
    - The strict or literal enforcement of the terms of this chapter, because of special conditions, will result in unnecessary hardship to the applicant.
    - There will not be unreasonable disruption of the natural terrain or unreasonable destruction of existing flora.
    - There is no reasonable alternative to the requisite variance that will alleviate the difficulty or hardship complained of.
    - The variance will not be greater than the minimum required to alleviate the difficulty or hardship complained of.
- ZAPCO. The recommendation of zoning and planning commission shall include an analysis of whether:
    - The variance may violate the intent of this chapter or the goals of the city's comprehensive plan; and
    - The variance may have an adverse effect on neighborhood properties, or interfere with the respective owners' enjoyment thereof; and
    - When considering variance requests for nonresidential projects in the Commercial Overlay District, whether the variance, when considered as part of the proposed project (as a whole), furthers achievement of the land planning principles set forth in the city's master plan, attachment B, as codified in article 28.02 of this code.
- Conditions. The city council can impose, and the zoning and planning commission can recommend imposition of, reasonable conditions upon granting a variance if the conditions are related to the subject of the variance. When considering variance requests for nonresidential projects in the commercial overlay district are necessary to achieve one or more of the land planning principles set forth in the city's master plan, attachment B, as codified in article 28.02 of this code.

Outdoor Lighting

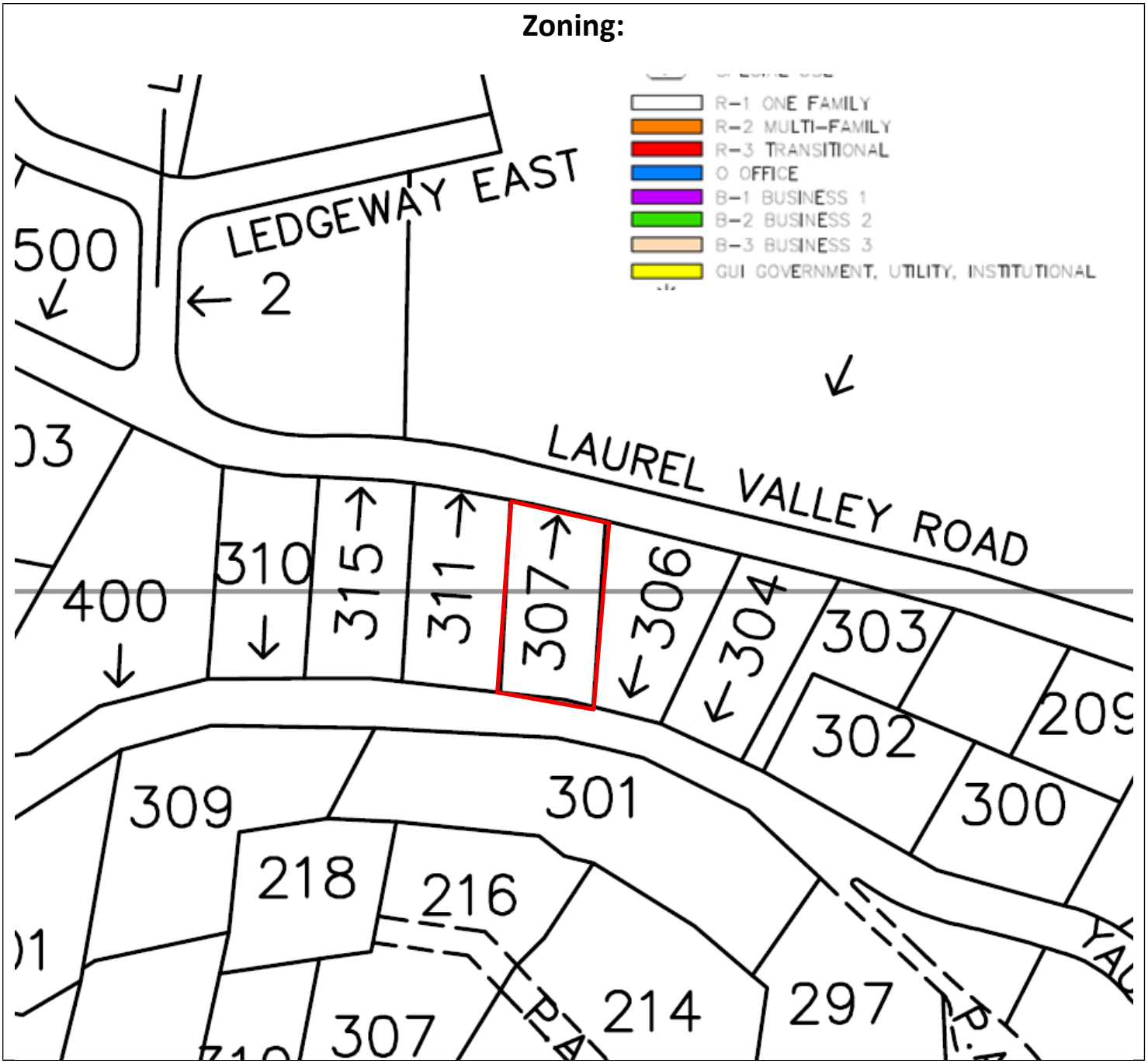
Outdoor lighting is not proposed with this variance request. Any outdoor lighting will need to comply with the City's Code.

Compliance with Adopted International Building Code
The property and future construction will have to comply with all applicable City codes.
Subdivision
There is no change to the subdivision proposed with this application.
Comprehensive Planning Analysis
The existing and future land use is in conformance with the City of West Lake Hills Master Plan.

Links to Relevant Code:

- **Section 22.03.304. Tree and vegetation removal and replacement.**
- **Section 22.03.511 Procedure and notice (for variance).**
- **Section 22.03.514 Criteria and process required for granting a variance.**

Zoning:


R-1 ONE FAMILY
R-2 MULTI-FAMILY
R-3 TRANSITIONAL
O OFFICE
B-1 BUSINESS 1
B-2 BUSINESS 2
B-3 BUSINESS 3
GUI GOVERNMENT, UTILITY, INSTITUTIONAL
LEDGEWAY EAST
LAUREL VALLEY ROAD
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Aerial:

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YAUPON VALLEY SUBD
114968
114969
301
Yaupon Valley Rd
YAUPON VALLEY RD
Yaupon Valley Rd
309
302
114946
SWEENEY CONFIRMING PLAT
114987
115003
AMENDING PLAT
114974
114999
301
300

January 29, 2026

Schmergel Residence
309 Laurel Valley (R1, .4371 acres)

Zoning and Planning commission members,

A quick note to orient you, this lot is addressed as 309 Laurel Valley, we will be using Yaupon Valley for our main access, and the lot will be readdressed Yaupon Valley. City staff informed us this is normal and does not require any additional requests. Our setbacks are based on Yaupon Valley being our front and Laurel Valley, the back.

This lot provides exceptional challenges given its 33% average natural slope (43% under building foundation). The design of this proposed residence is centered around providing a safe driveway experience as requested by our clients, a young family. Multiple options were studied to limit these requests. We feel like our design solution accomplishes our goals while staying in line with the city's vision and goals.

My team has met with City of Westlake development staff 3 times to review our project and consider their feedback. We were able to eliminate 2 requests based on that feedback.

We understand that drainage is always a concern for the city and its neighbors. We have engaged a civil engineer, Millian Engineering to guide us along the way. They have put together an initial drainage study, concept plan and narrative, attached.

Literal enforcement of the requested code variances below will provide hardship to develop this project as-is and provide an unsafe driveway experience. I believe our requests are in line with the city's comprehensive plan goals and do not violate the intent of those goals. This is a modest project by size and scale and fits in with the neighboring houses in character and scale.

REQUEST #1 – TREES

There is an existing tree violation on this property that has come up in our reviews with development staff. This violation was inherited by my clients from the previous owner. An illegal, non-permitted extensive tree clearing occurred and there is a significant tree caliper mitigation required. As part of this submittal, we are showing all areas we intend to provide this mitigation (bubbled, see sheet 1). Staff has asked for this mitigation to happen now, which we understand as before construction would start. We are proposing providing this mitigation as part of the project, happening after the building is in place. There is general concern for planting trees before and bringing in heavy equipment after for foundation and framing erection, especially on the slope. A proposed tree species list is on sheet 1.

Not providing this variance will require us to plant, protect and work around many young trees. The risk for damage and death of these trees would be significant once construction begins. Heavy equipment will be required to work on this slope, there is little area for construction staging, working in and around the tree protection on slope provides incredible safety concerns for subcontractors. Our client is committed to providing the necessary mitigation and will do so as part of the end of project landscaping, typical for any construction project.

REQUEST #2 - DRIVEWAY (HIGHER THAN 6' OUT OF NATURAL GRADE) **§ 22.03.175 (E-1)**

We are requesting the driveway variance to provide our clients with a useable, safe driveway first and foremost. Our driveway solution proposes a level bridge that connects street to garage. There is an initial 15% drop to the bridge driveway (see site/building section on page 2). Given the steepness of the lot, the bridge is higher out of grade than allowed. The proposed bridge driveway is raised on steel columns to provide a lighter, less heavy aesthetic as opposed to pouring concrete down to grade. The raised structure provides a way for sunlight and rainwater to reach the natural terrain below. Portions of the driveway will be open steel grate in another effort to allow sunlight and rainwater to reach natural terrain. A level turn around area has also been provided. This driveway approach significantly limits the impervious coverage and steepness that other driveway approaches do not.

Not providing this variance will require a much longer and steeper switch back driveway scheme to negotiate the slope, resulting in much more natural site disturbance, unnecessary impervious coverage and dangerous driveway conditions in future ice heavy weather events. The switchback scheme would also require a variance for driveway setback encroachment to achieve the minimum required driveway length.

REQUEST #3 - HEIGHT (35' ALLOWANCE) **§ 22.03.279 (B)**

We are requesting a 36" height increase from the allowed 32' max at our site slope of 33%. The amount of slope within our building footprint is at 43%. We determined our building location and vertical positioning thru various studies of the bridge driveway concept. As you can see on page 2 our single shed roof line follows the site's natural topography to reduce the scale of this building and comply with code goals. Small variations in that topography create moments where our roof becomes noncompliant. The front, street side roof edge is compliant and moves into noncompliance to the back of the building. The building height visible from the street is only 8'-6". Along with the positioning of our building in relation to the neighbors (see sheet 3), we see low visual impact from their properties and from the street.

Not providing this variance will require us to lower our building, thus creating the need for a much steeper driveway approach. Lowering the building 36" will eliminate the level bridge area and create a slope greater than the code limit of 20%.

REQUEST #4 - BUILDING SETBACKS (front and sides) **§ 22.03.281**

We are requesting to use a combination of City of Westlake required setbacks along with platted setbacks, in which, City of Westlake enforces the worse of the two. City of Westlake enforces a 30' front and 20' side setbacks on lots less than one acre. The platted setbacks are 50' front, 10' sides and 40' rear. We are requesting encroachments into the front and side setbacks. Specifically, 20' encroachment in the front setback and 10' encroachments into the side setbacks. The new 30' front complies with Westlake and allows us to provide the level driveway and turnaround as well as provide space downhill for our septic and tree mitigation requirements. The side setbacks allow us to provide a narrower building footprint front to back. Neighboring homes at 307 and 311 Laurel Valley are encroaching into the code prescribed side setbacks, see sheet 3. Our building is positioned significantly higher up the hill limiting the houses feeling too close together and hopefully limiting any changes in neighbor experience.

Not providing this variance will force us to reduce our building in width and add it to the depth. The further we push out on the site at a level elevation will push the building massing even further out of natural grade, making the building appear more massive. The tree mitigation and septic areas will be significantly limited with a deeper building.

REQUESTS #5 and 6 - CUT AND FILL (within and outside of code prescribed setbacks) **§ 22.03.170 (B) (F)**

We are requesting variances for cut and fill within city code buildable area as well as outside city code buildable area. Our building has a 43% slope under foundation which has limit of zero feet for closed cuts and zero feet for closed fill. The cut is consistent along the entire front of the building limiting site disturbance. The greatest cut amount is 8'-3", see sheet 2. The max fill amount on site is 15'-0" in height. Given the extreme slope it is difficult to stay closer to natural grade while keeping a level floor area. Due to the side setback request we would be cutting more than 18" into a prescribed setback.

Not providing this variance will require us to add additional stairways at the lower level both interior and exterior, disrupting the flow between spaces better experienced on one level. The lower level is all bedrooms, three of them for children, adding additional stairs creates disconnection and safety issues.

REQUEST #7 – GRADING ON SLOPE GREATER THAN 35% § **Drainage/Erosion Control Manual 7.4.1, table 7-1**

We are requesting a variance for grading as our building has a 43% natural slope under our foundation.
Not providing this variance will not allow us to proceed with development on much of this property given its natural topography.

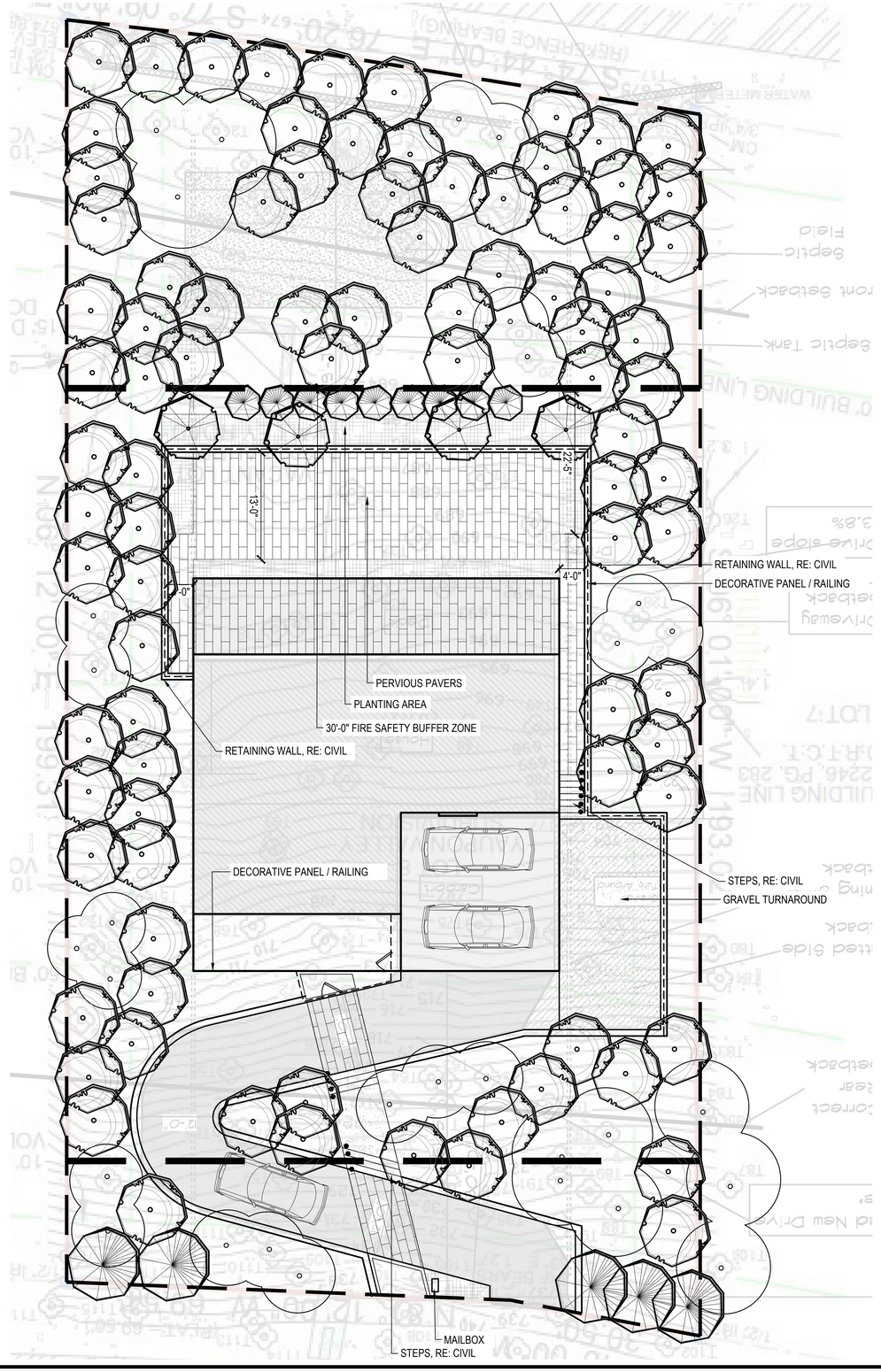
Thank you for the consideration.

Matt Garcia
Principal, Matt Garcia Design

Approved Tree Mitigation Plan
06/12/2023

Jennifer C. Bills

Director of Building & Development Services



LANDSCAPE LEGEND		
SYMBOL	DESCRIPTION	QTY.
	PROPERTY LINE	N/A
	30'-0" FIRE SAFETY BUFFER ZONE	N/A
	EXISTING TREE GROVE TO BE PRESERVED	N/A
	MEDIUM-LARGE TREES, OR APPROVED EQUIVALENT SPECIES (DECIDUOUS OR EVERGREEN) (4" CAL.)	89
	MEDIUM-LARGE TREES, OR APPROVED EQUIVALENT SPECIES (EVERGREEN ONLY) (3" CAL.)	5
	SMALL TREES/LARGE SHRUBS, OR APPROVED EQUIVALENT SPECIES (DECIDUOUS OR EVERGREEN) (3" CAL.)	4
	SMALL TREES/LARGE SHRUBS, OR APPROVED EQUIVALENT SPECIES (DECIDUOUS OR EVERGREEN) (3" CAL.)	9

TREE MITIGATION CALCULATIONS

DEFERRED ADJUDICATION MITIGATION REQUIREMENT *	408 CALIPER INCHES MITIGATION
TOTAL MITIGATION INCHES PLANTED ONSITE	408 CALIPER INCHES
MEDIUM-LARGE TREES, OR APPROVED EQUIVALENT SPECIES (DECIDUOUS OR EVERGREEN) - 4" CALIPER x 89 TREES = 356" REPLACEMENT	
MEDIUM-LARGE TREES, OR APPROVED EQUIVALENT SPECIES (EVERGREEN ONLY) - 3" CALIPER x 5 TREES = 15" REPLACEMENT	
SMALL TREES/LARGE SHRUBS, OR APPROVED EQUIVALENT SPECIES (DECIDUOUS OR EVERGREEN) - 3" CALIPER x 4 TREES = 12" REPLACEMENT	
SMALL TREES/LARGE SHRUBS, OR APPROVED EQUIVALENT SPECIES (DECIDUOUS OR EVERGREEN) - 3" CALIPER x 9 TREES = 27" REPLACEMENT	
TOTAL MITIGATION INCHES PAID INTO TREE FUND	$0.00

NOTES:

* PER MUNICIPAL COURT CAUSE NO 2300128297, 2300128298

ALL REPLACEMENT TREE SPECIES ARE SELECTED FROM THE LIST ON APPENDIX A.

309 LAUREL VALLEY - TREE CALCULATIONS

06/06/2023

NORTH

0 5 10 20

SCALE 1" = 10'

NORRIS DESIGN
Planning | Landscape Architecture | Branding

City of West Lake Hills

MINUTES OF A ZONING & PLANNING COMMISSION (ZAPCO)
REGULAR MEETING
Wednesday, February 18, 2026 at 6:30 PM

1. **Call to Order: Chair Robert Meisel**
    a. Meeting begins at 6:30pm
    b. Roll Call
        1. Chair Robert Meisel: Present
        2. Vice-Chair Jim Pledger: Present
        3. Commissioner Julia Webber: Present
        4. Commissioner Karen Bartoletti: Present
        5. Commissioner Patrick Stewart: Present
        6. Commissioner Laurie Maccini: Present

2. **Citizen Communications:**
    a. No public comments.

3. **Consent Agenda:** The following items are considered to be self-explanatory by the Commission and will be enacted with one motion. There will be no separate discussion of these item/s unless a Commission Member or citizen so requests.
    a. Approval of the January 21, 2026 Zoning and Planning Commission Minutes.
    b. Report of previous cases ZAPCO acted on by BOA/City Council.

    Action: Commissioner Stewart moves for approval of the Consent Agenda

        i. Commissioner Webber Seconds
        ii. Motion carries unanimously (5–0)

Chair Meisel moves the discussion of Item 7, 102 Swiftcurrent up on the agenda for discussion.

7. Discuss and consider a recommendation to Board of Adjustments on a variance to allow a second driveway when a maximum of one is allowed (Section 22.03.175(e)(2)).

Applicant: Francisco Rios,

A. Staff Report:

1. Director Bills details the replat of 100 Swiftcurrent which resulted in the property to be landlocked. Director Bills described the details of the proposed driveway with a curb cut on 102 Swiftcurrent to access the

easement on 98 Swiftcurrent to provide driveway access for 100 Swiftcurrent.

2. Chair Meisel calls to postpone the item to the March ZAPCO meeting
    1. The owners of 98 Swiftcurrent stated their objection to the postponement.

Chair Meisel moves the full discussion and consideration of Item 7to its initial place in the agenda.

4. Public Hearing **300 Block of Laurel Valley Rd:** Discuss and make recommendations on proposed variances:

    1. Allow for a driveway height greater than 6 feet above natural grade (Section 22.03.175(e)(1))

    2. Allow building height greater than 32 feet above natural grade on a slope of 25% or greater (Section 22.03.279(b))

    3. Encroach 20 feet into the platted 50-foot front building setback along Yaupon Valley Road (Section 22.03.281)

    4. Encroach 15 feet into both 25-foot side setbacks (Section 22.03.281)

    5. Allow fills up to 15 feet where the maximum allowed is 6 feet on slopes of less than 35% (Section 22.03.170(b)– Drainage and Erosion Control Design Manual Section 7.4.1)

    6. Allow for grading in areas of slopes greater than 35% where none is allowed (Section 22.03.170(b)– Drainage and Erosion Control Design Manual Section 7.4.1)

    7. Allow grading greater than 18 inches within setbacks (Section 22.03.170(f)).

    Applicant: Matt Garcia

Note: Items 4 and 5 are related to the same property and are separate due to Zoning variance requests being forwarded to the Board of Adjustments while the Tree variance request is forwarded to City Council. They were largely discussed as a single item, recorded in the minutes for item 4, while the motions were separated.

A. Staff Report:

a. **Director Bills** describes the history of the property and the variance requests.

b. **Chair Meisel** asks why the property is taking access off of Yaupon Valley Road instead of Laurel Valley.

c. **Commissioner Webber** asks if there is room on the property with the proposed development to replace the illegally-removed trees.

B. Public Comments:

a. **Matt Garcia – Applicant**

1. Indicates that trees had been removed by prior owner
2. Speaks in favor of variance requests

b. A letter (Attached to minutes as "Exhibit A") in opposition to the variances from Steve Brown of 300 Cedar Oak Drive was read into the record

c. A letter (Attached to minutes as "Exhibit B") in opposition to the variances from Jane Noble of 801 Yaupon Valley Road was read into the record

C. Discussion:

a. **Commissioner Webber** asks what the proposed square footage of the new house is.

1. **Matt Garcia:** 4320 square feet

b. **Commissioner Maccini** asks if there has been a recent tree survey of the property.

1. **Director Bills:** None has been provided.

c. **Commissioner Webber:** The scope of the variances represents a mockery of city code.

d. **Chair Meisel** indicates that according to the Appraisal District, the ownership hasn't changed since 2020, and that it was this owner that removed the trees.

e. **Commissioner Webber**: Space required for tree mitigation needs to be quantified.

f. **Commissioner Pledger:** There is no hardship, and the magnitude of variances requested would require a dramatic hardship.

D. Action:

a. **Commissioner Webber** moves to forward all variance requests to the Board of Adjustment with a recommendation of **denial** for lack of hardship.

1. Commissioner Pledger seconds,
2. Motion carries unanimously (5-0).

The variance request and recommendation will be forwarded to the March 11, 2026 Board of Adjustments Meeting.

5. Public Hearing **300 Block of Laurel Valley Rd:** Discuss and make recommendations on proposed variances:

   Allow replacement trees for unpermitted removals to be planted at the end of the project, more than 601 days since the final order (Section 22.03.304(c)(5).

Applicant: Matt Garcia

Note: Items 4 and 5 are related to the same property and are separate due to Zoning variance requests being forwarded to the Board of Adjustments while the Tree variance request is forwarded to City Council. They were largely discussed as a single item, recorded in the minutes for item 4, while the motions were separated.

A. **Staff Report:**
    a. See minutes for item 4
B. **Public Comments:**
    a. See minutes for Item 4
C. **Discussion:**
    a. See minutes for item 4
D. **Action:**

    a. **Commissioner Bartoletti** moves to forward the variance request to the Board of Adjustment with a recommendation of **denial** for lack of hardship.
        i. Commissioner Webber seconds
        ii. Motion carries unanimously (5-0)

The variance request and recommendation will be forwarded to the March 11, 2026 City Council Meeting.

6. Public Hearing **101 Westhaven Dr. :** Discuss and make a recommendation to Board of Adjustment on variances to allow for an accessory structure:

    1. To encroach 22 feet into the 30-foot front setback along Bee Cave Road (Section 22.03.276 and 22.03.281)

    2. To encroach 20 feet into the 25-foot rear setback (Section 22.03.276 and Section 22.03.281)

Applicant: Pramod Patil, Property Owner

A. Staff Report:
    a. Director Bills details that proposed shed to be in a similar location after a storm destroyed the existing shed.
    b. Director Bills shares that the lot lost 14 feet of the front setback to TXDOT's expansion of Bee Cave Rd.

c. Stewart asks if the shed was there before 2014 and if it has HVAC, Plumbing, Water.
    a. Director Bills states that the shed would just have electric.
d. Bartoletti asks if the shed was in the setback prior to the sale of the portion of the lot.
    a. Director Bills says yes.
e. Pledger asks if the shed predates the setback code.
    a. Director Bills states she is unsure of how old the original shed was, but not older than 2002 according to a survey of the property provided by the applicant.

B. Public Comments:

a. **Pramod Patil** - Applicant:
    1. Presented request for variance.

C. Discussion:

a. Commissioner Maccini states that the variance is a direct hardship and is in support of the variances.

b. Commissioner Webber thanks Patil for the presentation and is in support.

D. Action:

a. Commissioner Maccini moves to forward the variances to City Council with a recommendation of **approval**.
    a. Commissioner Webber seconds,
    b. Motion carries (5-0) unanimously.

The variance request and recommendation will be forwarded to the March 11, 2026 Board of Adjustments Meeting.

7. **102 Swiftcurrent**. Discuss and consider a recommendation to Board of Adjustments on a variance to allow a second driveway when a maximum of one is allowed (Section 22.03.175(e)(2))

   Applicant: Francisco Rios, Property Owner

Note: Chair Meisel chose to recuse himself from the discussion on the variance request because he was involved in the prior replat of the property as the property owner. Vice-Chair Pledger led the discussion on this item.

a. Staff Report:

1. **Director Bills** details that the only applicant on record is 102 Swiftcurrent.

2. **Commissioner Bartoletti** states that the variance request should be postponed to the next meeting because of insufficient information to the application.
3. **Commissioner Pledger** asks why the other two property owners were not on the application
4. Maccini asks to hear from the applicant
5. Bartoletti asks Director Bills and Assistant City Attorney Thamm if the applicant owns the property
    1. **Director Bills** clarifies that the applicant owns 102 Swiftcurrent, but that the goals of the applicants are to receive the variance and sell the portion of the property for which the variance is requested to the owners of 98 Swiftcurrent.
        a. If the property lines are moved, the properties would need to go through the subdivision process prior to additional development.

b. Public Comment:

1. Francisco Rios, Applicant:
    1. Clarified the comments made by the commission and agrees with the commission that all three parties should be involved.

c. Discussion:

1. Pledger asks the applicant to postpone to the March ZAPCO meeting
2. Director Bills shares her recommendation of 98 Swiftcurrent to be the applicant/agent, with 102 Swiftcurrent providing power of attorney.
3. Maccini asks who will eventually own the driveway.
    1. As proposed by the current owners of 98 and 102 Swiftcurrent, Director Bills states that 98 Swiftcurrent will own the driveway
4. Pledger states the applicant should be the owner of the driveway and all parties be included.
5. Webber states that part of the application should include the impervious cover calculations.
    1. Webber asks if it's appropriate for 98 Swiftcurrent to be the applicant.
        a. Development Coordinator Sherrouse explains that the City has a standard Power of Attorney form that can be submitted to the application to allow the application to represent multiple properties.
6. Applicant requests postponement to the March 18, 2026 ZAPCO meeting.

d. Action:

1. Bartoletti moves that the request be postponed to the March 18, 2026 ZAPCO Meeting
    1. Commission Webber seconds,
    2. The vote passes (5-0) unanimously.

The variance request is postponed to the March 18, 20206 ZAPCO meeting

Chair Robert Meisel returns to the dais.

8. **Adjournment**

Chair Meisel adjourns the meeting at 7:48pm

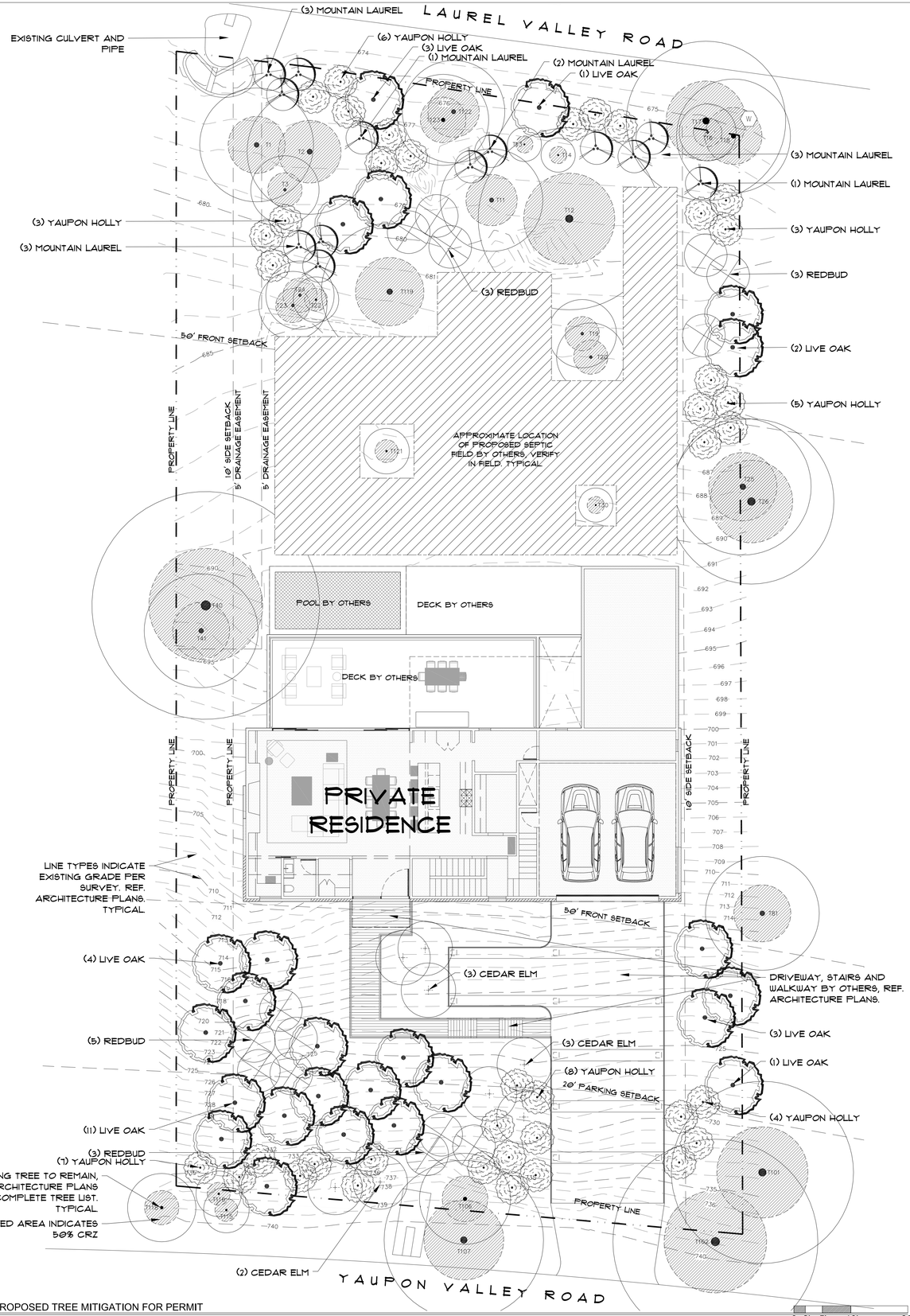
APPROVED:

Robert Meisel, Chair

ATTEST:

Joel Sherrouse, Development Coordinator

These minutes were approved on March 18, 2026.



2 PROPOSED TREE MITIGATION FOR PERMIT
SCALE: 1" = 10'

NOTES:

CONTRACTOR RESPONSIBLE FOR PROVIDING AND ENSURING ALL PROPER DRAINAGE FOR SITE. SLOPE AWAY FROM POOL AND BUILDING, PREVENT ANY POOLING OR STANDING WATER OR WATER ENTERING THE HOUSE OR POOLING IN LAWN AND BED AREAS, ENSURE NEIGHBORING PROPERTIES AREN'T AFFECTED BY DRAINAGE OR RUNOFF.

CONTRACTOR TO VERIFY ALL EXISTING AND PROPOSED UTILITIES, TREES, PROPERTY LINES, EASEMENTS, ETC.., GRADES, ELEVATIONS,QUANTITIES, DIMENSIONS OF EXISTING AND PROPOSED HARDSCAPE AND SOFTSCAPE ELEMENTS IN FIELD PRIOR TO INSTALLATION. VERIFY GRADES AND LAYOUT ELEMENTS FOR APPROVAL PRIOR TO INSTALLATION. CONTRACTOR RESPONSIBLE FOR ALL STRUCTURAL, WATERPROOFING AND DRAINAGE ASPECTS OF PROJECT. CONTRACTOR RESPONSIBLE FOR REPAIRING ANY DAMAGED UTILITY LINES OR ANY OTHER FORM OF DAMAGE TO SITE. ALL GRADES ARE ESTIMATED, VERIFY IN FIELD. NOTIFY OWNER IF ANY UTILITIES, EASEMENTS, ETC.. INTERFERE OR CONFLICT WITH PROPOSED PLAN ITEMS PRIOR TO INSTALLATION. NOTIFY OWNER OF ANY CONCERNS, DISCREPANCIES OR ISSUES.

CONTRACTOR TO FOLLOW ANY AND ALL APPLICABLE RULES, PERMITTING PROCESS REQUIRED, SEEK ANY AND ALL REQUIRED REGULATORY APPROVAL, CODES AND ORDINANCES. CONTRACTOR RESPONSIBLE FOR INSTALLING AND DETERMINING ALL LOCATIONS FOR GATES, GUARDRAILS, HANDRAILS, AND POOL FENCE PER CODE AS REQUIRED, VERIFY ON SITE.

ACTUAL LOCATIONS AND SPECIES OF TREES MAY BE ADJUSTED DURING CONSTRUCTION BUT ALL FINAL TREE MITIGATION WILL BE IN COMPLIANCE OF CITY OF WEST LAKE HILLS PER THE DESIGN ORDINANCE.

CLIENT AND HOMEBUIDLER ARE RESPONSIBLE FOR NOTIFYING DOUBLE B DESIGN, LLC IN WRITING MINIMUM 10 BUSINESS DAYS PRIOR TO INSTALLING LANDSCAPE AS SHOWN ON THESE PLANS TO COORDINATE FINAL CONSTRUCTION DRAWINGS AND SCHEDULE A PRE-CONSTRUCTION MEETING.

PROPOSED TREE MITIGATION:
REFERENCE ARCHITECTURE PLANS FOR TREE PRESERVATION & REMOVAL PLAN, TREE REMOVAL CHART LIST AND OTHER TREE MITIGATION DETAILS AND SURVEY INFORMATION.

REQUIRED TREE MITIGATION INCHES: 409"

TREE MITIGATION PROVIDED: 409"

TREE MITIGATION PROVIDED THROUGH SEC. 22.03.304(D)(9) CALCULATIONS (BREAKDOWNS OF EACH GALLON SIZE BELOW CHART)

QTY. PROPOSED	PLANTING CONTAINER SIZE	EQUIVALENT TRUNK DIAMETER	TOTAL MITIGATION INCHES
0	20 GALLON	3"	0
13	30 GALLON	4"	52
50	40 GALLON	5"	250
		TOTAL	302"

(13) 30 GALLON ABOVE (4" EQUIVALENT) (13 x 4" = 52")
• (13) TEXAS MOUNTAIN LAUREL

(50) 45 GALLON ABOVE (5" EQUIVALENT) (50 X 5" = 250")
• (36) YAUPON HOLLY
• (14) REDBUD

(25) 3" CALIPER TREES (25 x 3" = 75")
• (25) LIVE OAK

(8) 4" CALIPER TREES (8 x 4" = 32")
• (8) CEDAR ELM

TOTAL INCHES PROPOSED 52"+250"+75"+32" =409"

PLANT LIST

SHADE CANOPY TREES

SYMBOL	QTY.	PLANT NAME	SIZE
	25	LIVE OAK *Quercus virginiana*	3" CAL.
	8	CEDAR ELM *Ulmus crassifolia*	4" CAL.

ORNAMENTAL TREES

SYMBOL	QTY.	PLANT NAME	SIZE
	36	YAUPON HOLLY *Ilex vomitoria*	45 GAL.
	13	TEXAS MOUNTAIN LAUREL *Sophora secundiflora*	30 GAL
	14	MEXICAN RED BUD *Cercis canadensis var. mexicana*	45 GAL

1 PLANT LIST

DOUBLE B DESIGN

DOUBLE B DESIGN, LLC
P.O. BOX 340443
Austin, TX 78734 | 512.740.9323
WWW.DOUBLEBLANDDESIGN.COM

PLANS FOR REVIEW PURPOSES ONLY. BRIAN BAUGHMAN, TXLA 3536. NOT ISSUED FOR REGULATORY APPROVAL, PERMITTING OR CONSTRUCTION.

3-11-2026

PRIVATE RESIDENCE
309 LAUREL VALLEY ROAD | WEST LAKE HILLS, TX

DRAWING INFO.
DATE:2026-3-11
FILE NAME:26109

REVISIONS
1)
2)
3)
4)
5)

SHEET TITLE
PROPOSED TREE MITIGATION FOR PERMIT

TM 1.1

LEGEND

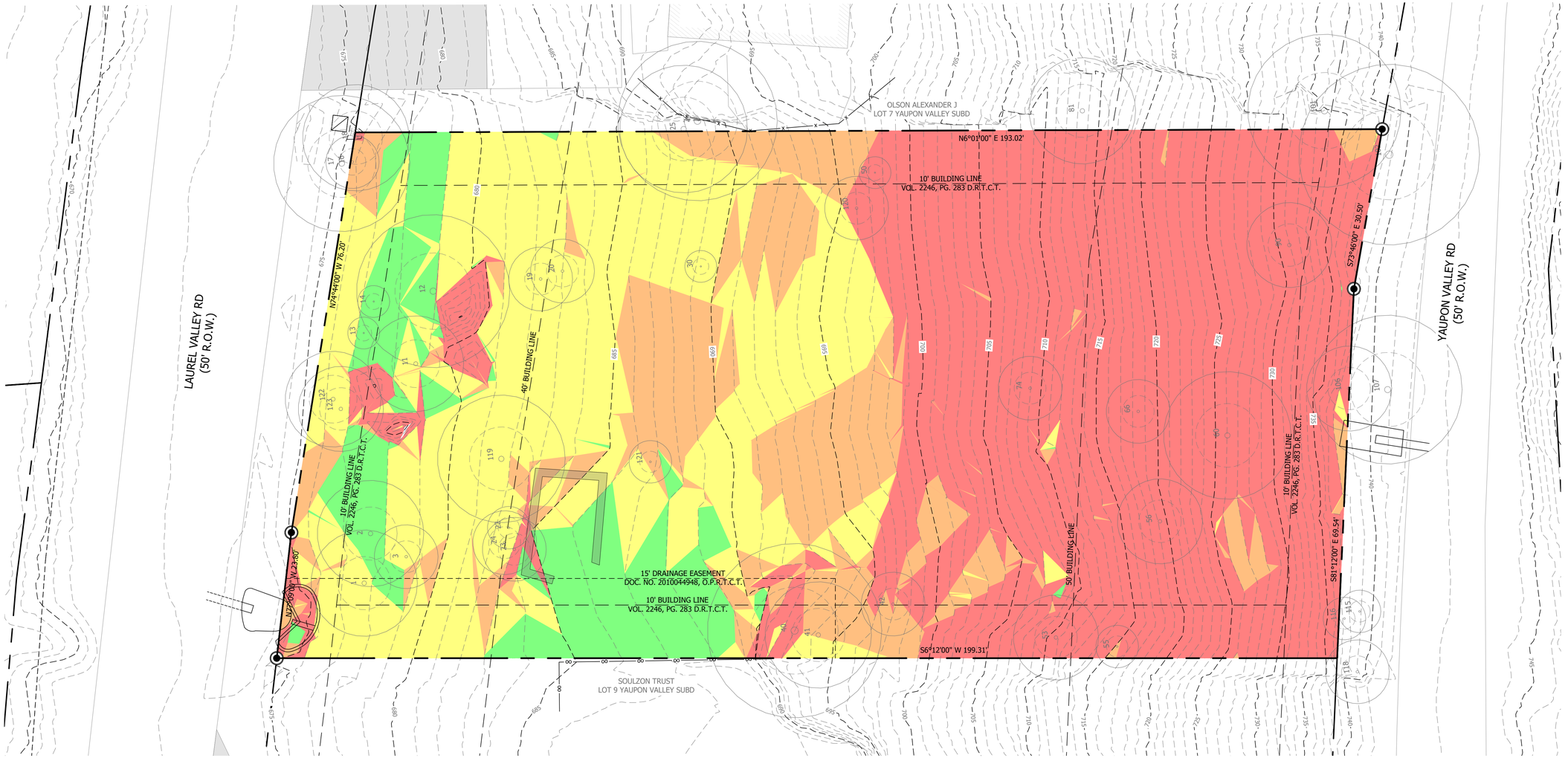
- BOUNDARY / RIGHT OF WAY
- OU — OVERHEAD UTILITY LINE
- PROPOSED BUILDING
- PROPOSED CONCRETE SIDEWALK
- PROPOSED PAVEMENT
- PROPOSED SOLID FENCE
- SURVEY CONTROL POINT
- EDGE OF PAVEMENT
- E — PROPOSED ELECTRIC MANHOLE
- TREE TO REMAIN
- 0% - 15% SLOPE
- 15% - 25% SLOPE
- 25% - 35% SLOPE
- OVER 35% SLOPE

N

0' 5' 10' 20'

SCALE: 1"=10'

SLOPES TABLE EG ON SITE					
Number	Minimum Slope	Maximum Slope	Color	AREA (SF)	AREA (AC)
1	0.00%	15.00%		1738.75	0.04
2	15.00%	25.00%		5783.11	0.13
3	25.00%	35.00%		2981.19	0.07
4	35.00%	313.00%		8852.00	0.20



NO.	DATE	DESCRIPTION

MILIAN
ALEJANDRA@MILIANENGINEERING.COM
FIRM REG# F-22686
830.513.9451

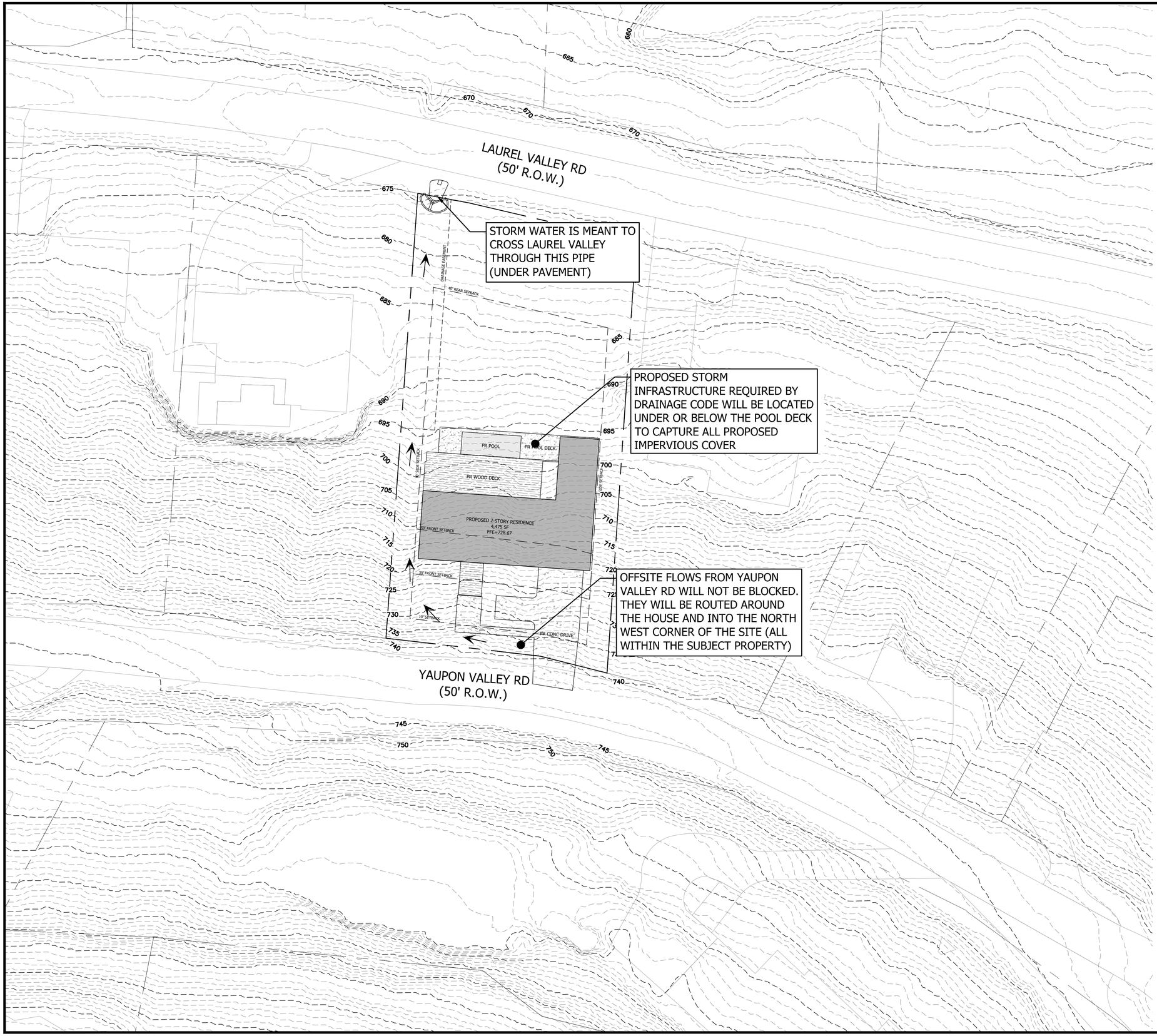
STATE OF TEXAS
ALEJANDRA FLORES S.
149401
LICENSED PROFESSIONAL ENGINEER
03/06/2026

RESIDENTIAL DRAINAGE PLAN

309 LAUREL VALLEY RD
WEST LAKE HILLS, TRAVIS COUNTY, TEXAS 78746

SLOPE MAP EXHIBIT

1 OF 1



N

0' 10' 20' 40'

SCALE: 1"=20'

LEGEND

- BOUNDARY / RIGHT OF WAY
- OU — OVERHEAD UTILITY LINE
- PROPOSED BUILDING
- PROPOSED CONCRETE SIDEWALK
- PROPOSED PAVEMENT
- PROPOSED SOLID FENCE
- SURFACE FLOW DIRECTION ARROW

NO.	DATE	DESCRIPTION

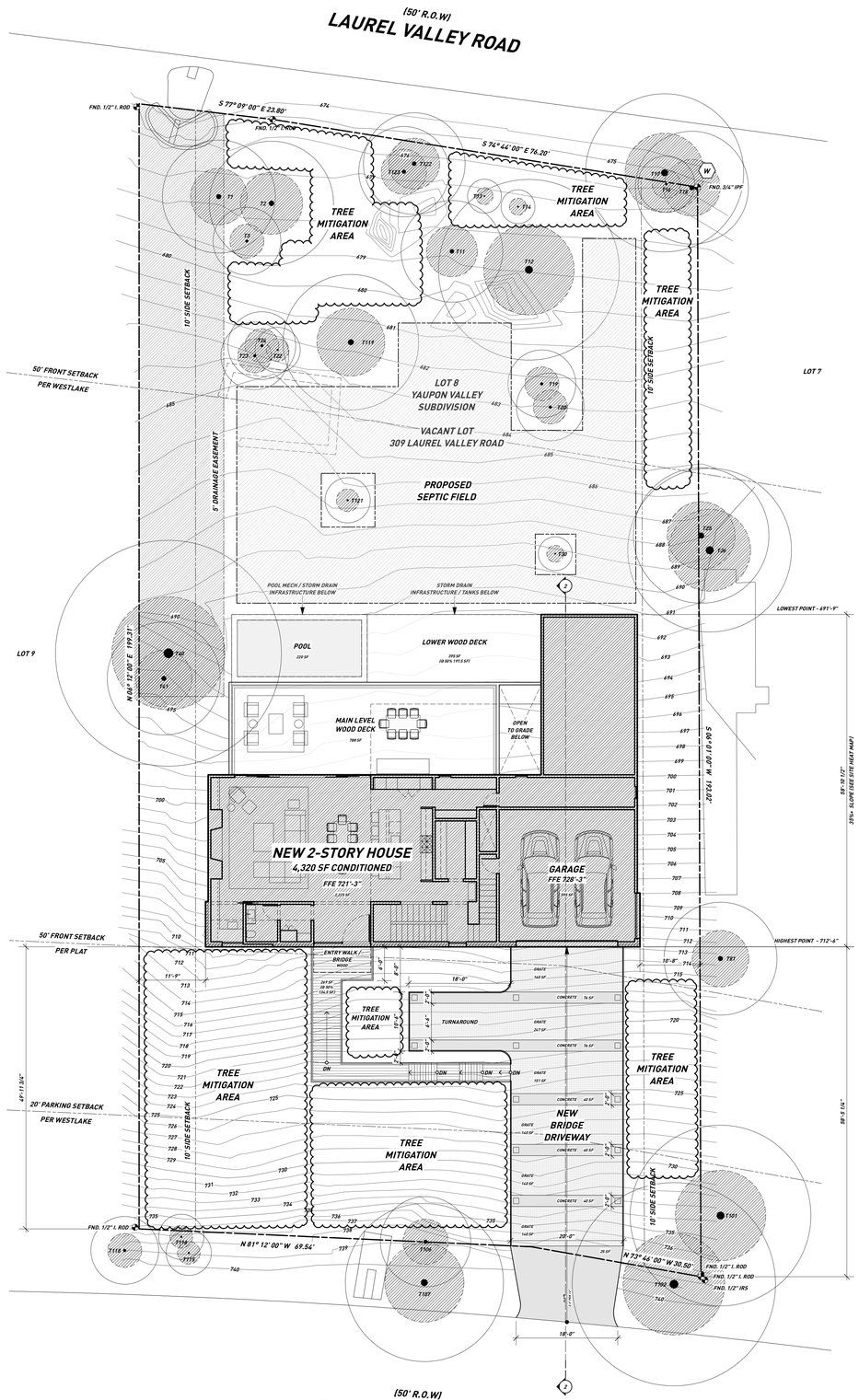
MILIAN
ALEJANDRA@MILIANENGINEERING.COM
FIRM REG# F-22686
830.513.9451

STATE OF TEXAS
ALEJANDRA FLORES S.
149401
LICENSED PROFESSIONAL ENGINEER
12/09/2025

RESIDENTIAL DRAINAGE PLAN

309 LAUREL VALLEY RD
WEST LAKE HILLS, TRAVIS COUNTY, TEXAS 78746

DRAINAGE PLAN EXHIBIT



1 SITE PLAN
1" = 10 ft

SEE PROPOSED TREE MITIGATION PLAN

N

PROJECT DATA

309 LAUREL VALLEY RD
WEST LAKE HILLS, TX 78746

JURISDICTION: WESTLAKE
ZONING: R-1
COUNCIL DISTRICT: ?
COUNTY: TRAVIS
MAP GRID: ?

LEGAL DESCRIPTION

???

AREA CALCULATIONS

LOT (PER SURVEY)	**19,397 SF (.44 ACRES)**
IMPERVIOUS ALLOWED	**25% (4,839 SF)**

BUILDING COVERAGE

BUILDING FOOTPRINT (MAIN LEVEL)	2,225 SF
GARAGE	595 SF
MAIN LEVEL DECK	788 SF
POOL COPING	67 SF
LOWER WOOD DECK (@ 50%)	197.5 SF
TOTAL BUILDING COVERAGE	**3,872.5 SF**
BUILDING COVERAGE %	(20.0%)

IMPERVIOUS COVERAGE

BUILDING COVERAGE	3,872.5 SF
ENTRY STEPS / BRIDGE (WOOD @ 50%)	134.5 SF
DRIVEWAY (CONCRETE ONLY)	297 SF
POOL	220 SF
TOTAL IMPERVIOUS COVERAGE	**4,524 SF (23.3%)**
IMPERVIOUS COVERAGE ALLOWED	**4,839 SF (25%)**

SITE GENERAL NOTES

1. NO UNDERGROUND UTILITY TRENCHES PERMITTED IN THE 1/2 CRITICAL ROOT ZONE OR WITHIN 12' OF THE TRUNK, WHICHEVER DISTANCE IS GREATER.

2. TREE PROTECTION FENCING TO BE INSTALLED AT THE 1/2 CRZ OF TREES WITHIN THE AREAS OF CONSTRUCTION, STORAGE OR TRANSPORT IMPACT.

3. CONTRACTOR TO SET UP ON-SITE PRE-CONSTRUCTION MEETING WITH ARBORIST AND MATT GARCIA DESIGN TO REVIEW TREE PROTECTION.

4. NO PIERS WITHIN 5' OF TREE TRUNKS.

5. NO ACCESS, PARKING OR MATERIAL STORAGE WITHIN LIMITS OF TREE PROTECTION FENCE.

6. ALL ROOT CUTS TO BE CLEAN (NO FRAYED EDGES).

7. FERTILIZE TREE ROOTS AND PROVIDE IRRIGATION DURING CONSTRUCTION ON A REGULAR BASIS.

8. APPLY MULCH AT CRITICAL ROOT ZONES OF ALL TREES.

9. MINIMIZE DISTURBANCE OF EXISTING GRADE AND LANDSCAPE WHEREVER POSSIBLE, WHILE PROVIDING POSITIVE DRAINAGE AWAY FROM THE HOUSE.

10. AFTER CONSTRUCTION, AIRSPADE ALL TREES WHERE CONSTRUCTION ACTIVITIES HAVE COMPACTED SOIL WITHIN THE CRITICAL ROOT ZONE.

11. COORDINATE AREAS FOR MATERIAL STORAGE AND DELIVERY WITH MGD AND PREPARE SUCH AREAS SO THAT THEY CAN BE EFFECTIVELY USED FOR DELIVERIES.

12. CONTRACTOR IS RESPONSIBLE FOR MAINTAINING AND REGULARY INSPECTING THE SILT FENCE DURING CONSTRUCTION/DEMOLITION INCLUDING THE REMOVAL AND PROPER DISPOSAL OF ANY ACCUMULATED SILT AND DEBRIS.

13. CONTRACTOR WILL NOT BEGIN WORK UNTIL THE SILT FENCE AND TREE PROTECTION HAVE BEEN INSTALLED.

14. NOTIFY "ONE-CALL" OR APPROPRIATE AUTHORITY TO LOCATE EXISTING UTILITY LINES AND PROTECT ALL UTILITIES FROM EXCAVATION OR SIMILAR HAZARDS.

15. PROTECT STRUCTURES, SIDEWALKS, PAVEMENTS AND OTHER FACILITIES FROM DAMAGE CAUSED BY SETTLEMENT, LATERAL MOVEMENT, UNDERMINING, WASHOUT AND OTHER HAZARDS CREATED BY EARTHWORK OPERATIONS.

16. LIMITS OF CONSTRUCTION - THIS SITE IS NOT SUBJECT TO LIMITS OF CONSTRUCTION. ALL AREAS OF THE SITE CAN BE UTILIZED FOR CONSTRUCTION ACTIVITY EXCEPT AREAS REQUIRED FOR TREE PROTECTION.

ABBREVIATIONS

TPF - TREE PROTECTION FENCE
PSRW - PLATE STEEL RETAINING WALL
TOW - TOP OF WALL

TREE PLAN NOTES

MAIN SITE ACCESS ROUTE

HALF CRZ OF PROTECTED TREES

TEMPORARY TREE PROTECTION FENCING (CHAIN LINK, 5' TALL)

8" MULCH LAYER

1. PRIOR TO TO DEVELOPMENT, CONTRACTOR TO PROVIDE A ROOT ZONE MULCH LAYER AND MAINTAIN TREE PROTECTION FENCING (CHAIN LINK, FIVE FOOT TALL) FOR ALL PROTECTED TREES ON THE SITE FOR THE DURATION OF THE PROJECT. SEE DIAGRAM IMAGE BELOW.

2. A 8" LAYER OF MULCH WITHIN THE ENTIRE AVAILABLE ROOT ZONE AREA IS REQUIRED FOR TREES WHICH HAVE ANY DISTURBANCE INDICATED WITHIN ANY PORTION OF THE CRITICAL ROOT ZONE. SEE DIAGRAM BELOW.

3. THERE SHALL BE NO UTILITY ROUTES OR METERS WITHIN THE 1/2 CRZ OF PROTECTED TREES ON THE SITE.

4. THERE SHALL BE NO ACCESS ROUTES, MATERIAL STAGING, CONCRETE WASHOUTS, DUMPSTERS, SCAFFOLDING, OR PORTABLE TOILETS WITHIN THE CRZ OF PROTECTED TREES ON THE SITE.

5. 2x4 PLANKS, 6' TALL MIN, TO BE STRAPPED SECURELY AROUND ALL PROTECTED TREE TRUNKS AND ROOT FLARES WHEN PROTECTIVE FENCING DOES NOT INCORPORATE THE ENTIRE 1/2 CRZ FOR ANY REASON AT ANY TIME IN THE PROJECT. SEE DIAGRAM BELOW.

6. THERE SHALL BE NO PRUNING OF PROTECTED TREES WITHOUT THE ASSESMENT BY A PRIVATE CERTIFIED ARBORIST. PAID RECEIPTS FOR ANY NEEDED WORK ON PROTECTED SIZE TREES WILL BE REQUIRED BY THE FINAL TREE INSPECTOR.

7. AT LEAST 50% OF THE TOTAL AREA OF THE OF THE CRITICAL ROOT ZONE OF PROTECTED TREES MUST BE PRESERVED AT NATURAL GRADE WITH NATURAL GROUND COVER PER ECM SECTION 3.5.2.

EXIST TREE LIST

T1	10" TREE	T81	10" OAK
T2	6" & 8" OAK	T101	8" & 12" OAK
T3	6" OAK	T102	12" & 12" CEDAR
T11	9" HACKBERRY	T106	8" ELM
T12	8" & 12" OAK	T107	14" OAK
T13	3" HACKBERRY	T115	4" HACKBERRY
T14	3" HACKBERRY	T116	4" HACKBERRY
T16	5" OAK	T118	6" HACKBERRY
T17	10" & 8" OAK	T119	12" MULTI-TRUNK OAK
T18	10" CEDAR	T121	4" YAUPON
T19	6" HACKBERRY	T122	9" RED OAK
T20	6" HACKBERRY	T123	8" RED OAK
T22	4" OAK		
T23	6" HACKBERRY		
T24	6" HACKBERRY		
T25	12" OAK		
T26	12" & 9" OAK		
T30	3" CEDAR		
T40	14" 4" & 6" OAK		
T41	10" CEDAR		

MATT GARCIA
DESIGN

3609 BONNIE ROAD
AUSTIN, TEXAS, 78703

TELEPHONE 512.522.5401

www.mattgarciadesign.com

PROJECT

SCHMERGEL RESIDENCE

309 LAUREL VALLEY RD
WEST LAKE HILLS, TEXAS 78746

CLIENTS
GRAHAM & PAIGE SCHMERGEL

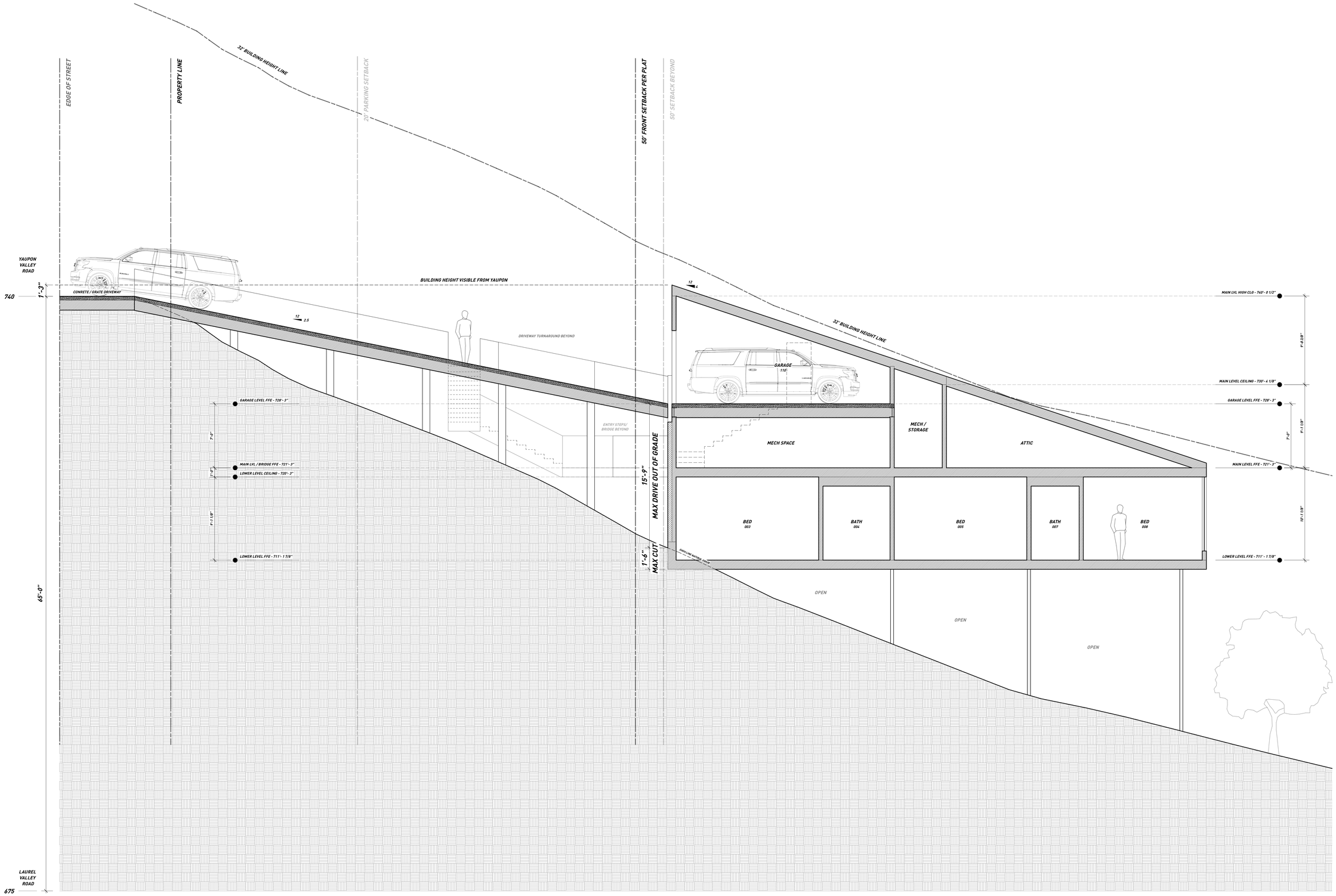
DESIGN
MATT GARCIA DESIGN
CONTACT: MATT GARCIA
EMAIL: mattgarciadesign@gmail.com
PHONE: 210.861.0978

ISSUE
VARIANCE SUBMITTAL - 2025 DEC 15
VARIANCE SUBMITTAL - 2026 JAN 30
VARIANCE SUBMITTAL - 2026 MAR 04
VARIANCE SUBMITTAL - 2026 MAR 11

TITLE ***SITE PLAN***

DATE ***MARCH 11 2026***

SHEET **1**



1 EAST SECTION
1/4" = 1'-0"

MATT GARCIA
DESIGN

3609 BONNIE ROAD
AUSTIN, TEXAS, 78703

TELEPHONE 512.522.5401

www.mattgarciadesign.com

PROJECT

SCHMERGEL RESIDENCE

309 LAUREL VALLEY RD
WEST LAKE HILLS, TEXAS 78746

CLIENTS
GRAHAM & PAIGE SCHMERGEL

DESIGN
MATT GARCIA DESIGN
CONTACT: MATT GARCIA
EMAIL: mattgarciadesign@gmail.com
PHONE: 210.861.0978

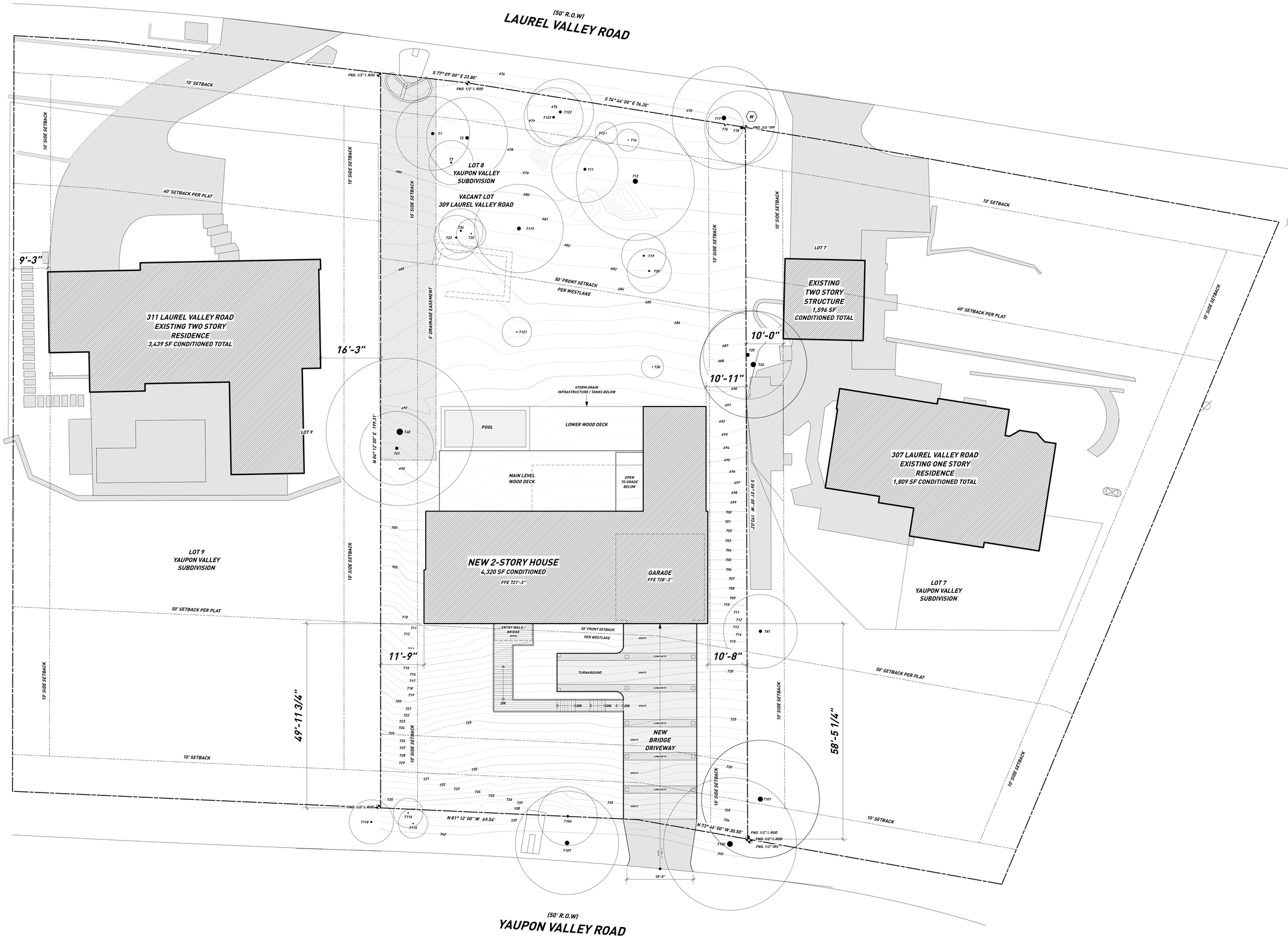
ISSUE
VARIANCE SUBMITTAL - 2025 DEC 15
VARIANCE SUBMITTAL - 2026 JAN 30
VARIANCE SUBMITTAL - 2026 MAR 04
VARIANCE SUBMITTAL - 2026 MAR 11

TITLE ***SECTION***

DATE ***MARCH 11 2026***

SHEET

2



1 SITE PLAN W/ NEIGHBORING PROPERTIES

1" = 10 ft

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TITLE SITE PLAN W/ NEIGHBOR PROP.

DATE MARCH 11 2026

SHEET 3

1 LOWER FLOOR PLAN

1/4" = 1'-0"

MAIN LEVEL (CONDITIONED)	**1,685 SF**
LOWER LEVEL (CONDITIONED)	**2,635 SF**
GARAGE	**595 SF**
TOTAL CONDITIONED	**4,320 SF**

5 BEDROOM/5.5 BATH

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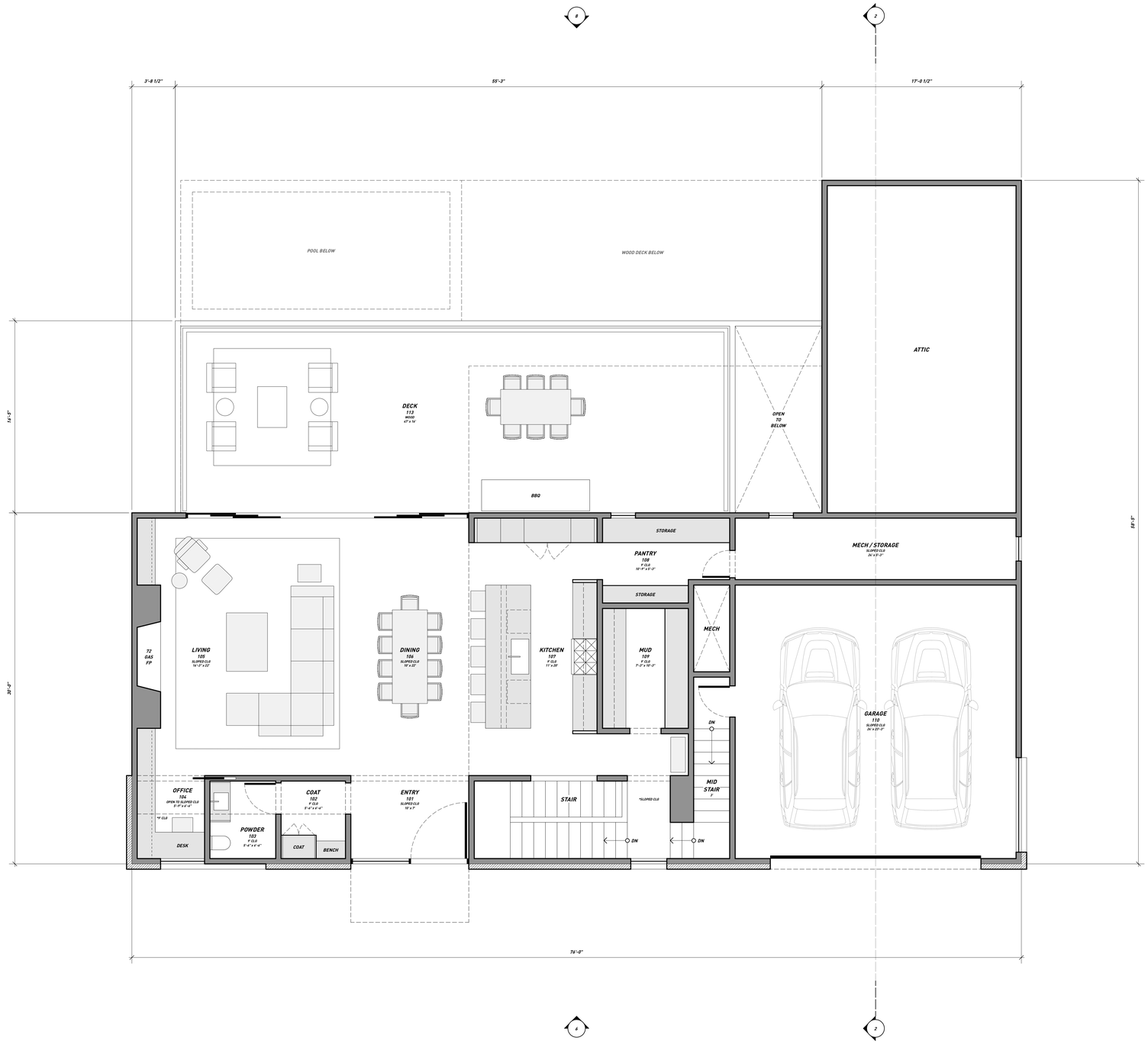
TITLE LOWER LEVEL PLAN

DATE MARCH 11 2026

SHEET 4



1 MAIN FLOOR PLAN

1/4" = 1'-0"

MAIN LEVEL (CONDITIONED)	1,685 SF
LOWER LEVEL (CONDITIONED)	2,635 SF
GARAGE	595 SF
TOTAL CONDITIONED	4,320 SF

5 BEDROOM/5.5 BATH

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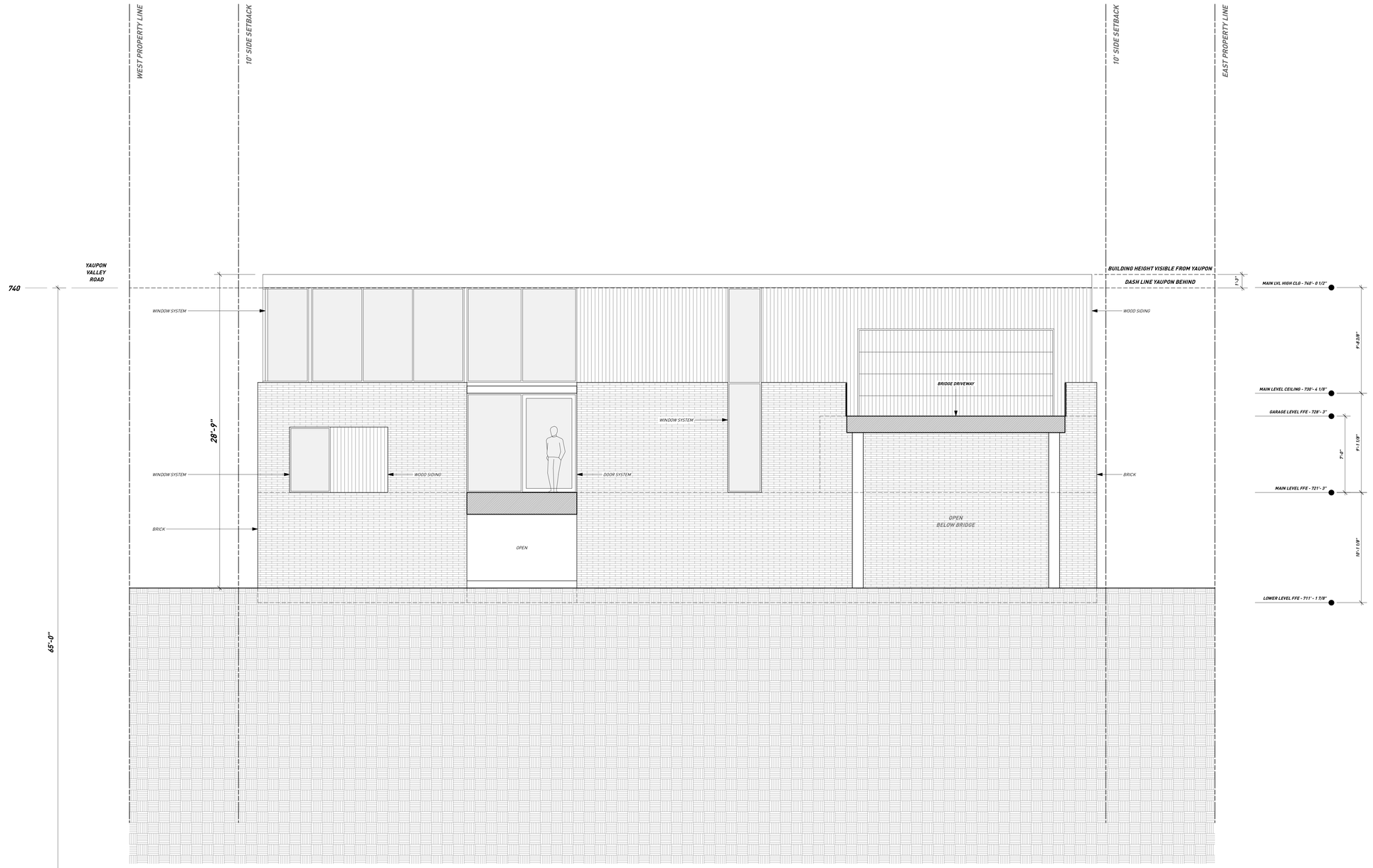
TITLE MAIN LEVEL PLAN

DATE MARCH 11 2026

SHEET

5



1 SOUTH ELEVATION
1/4" = 1'-0"

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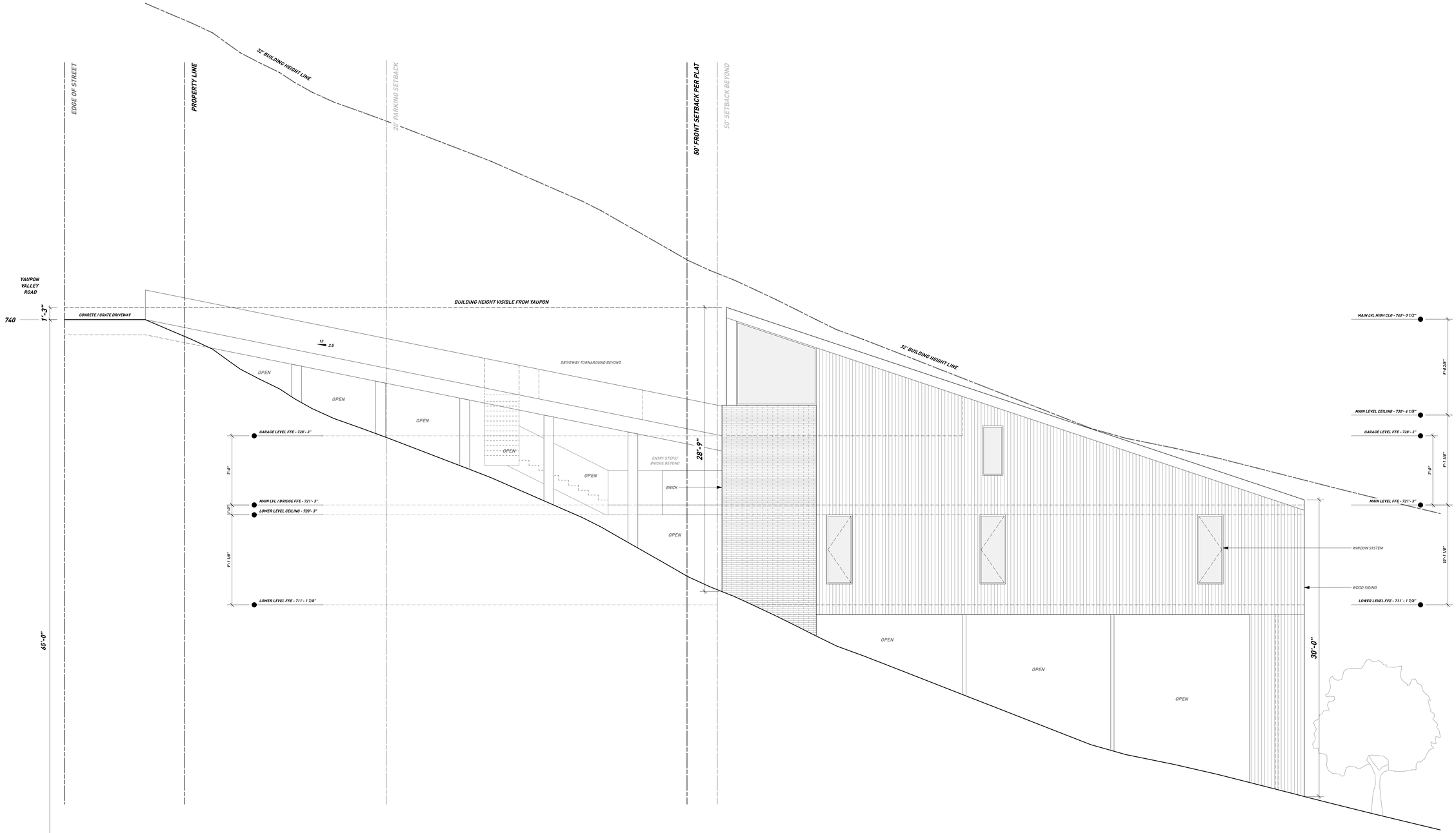
TITLE ***ELEVATIONS***

DATE ***MARCH 11 2026***

SHEET

6



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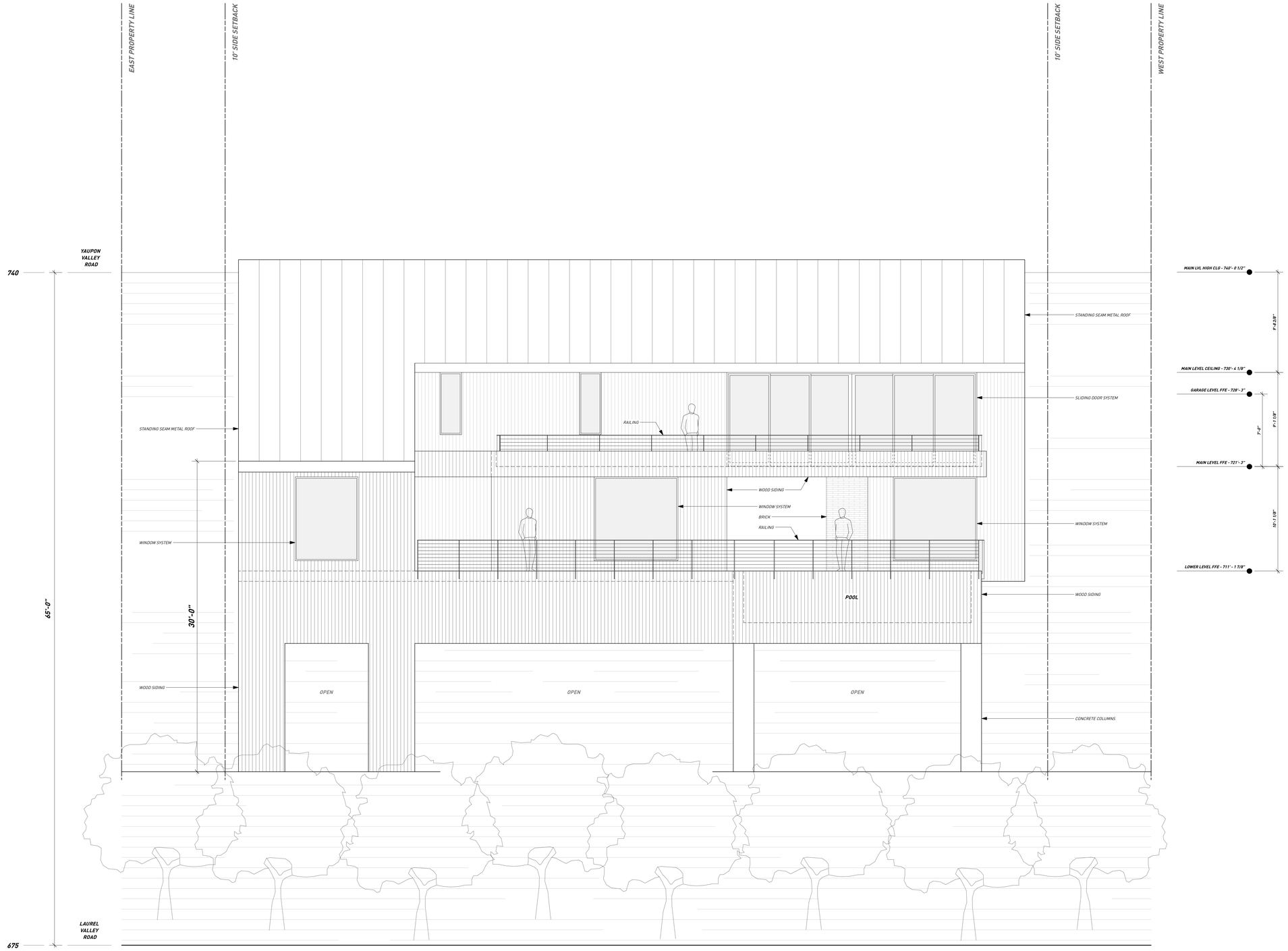
TITLE ***ELEVATIONS***

DATE ***MARCH 11 2026***

SHEET

7



1 NORTH ELEVATION
1/4" = 1'-0"

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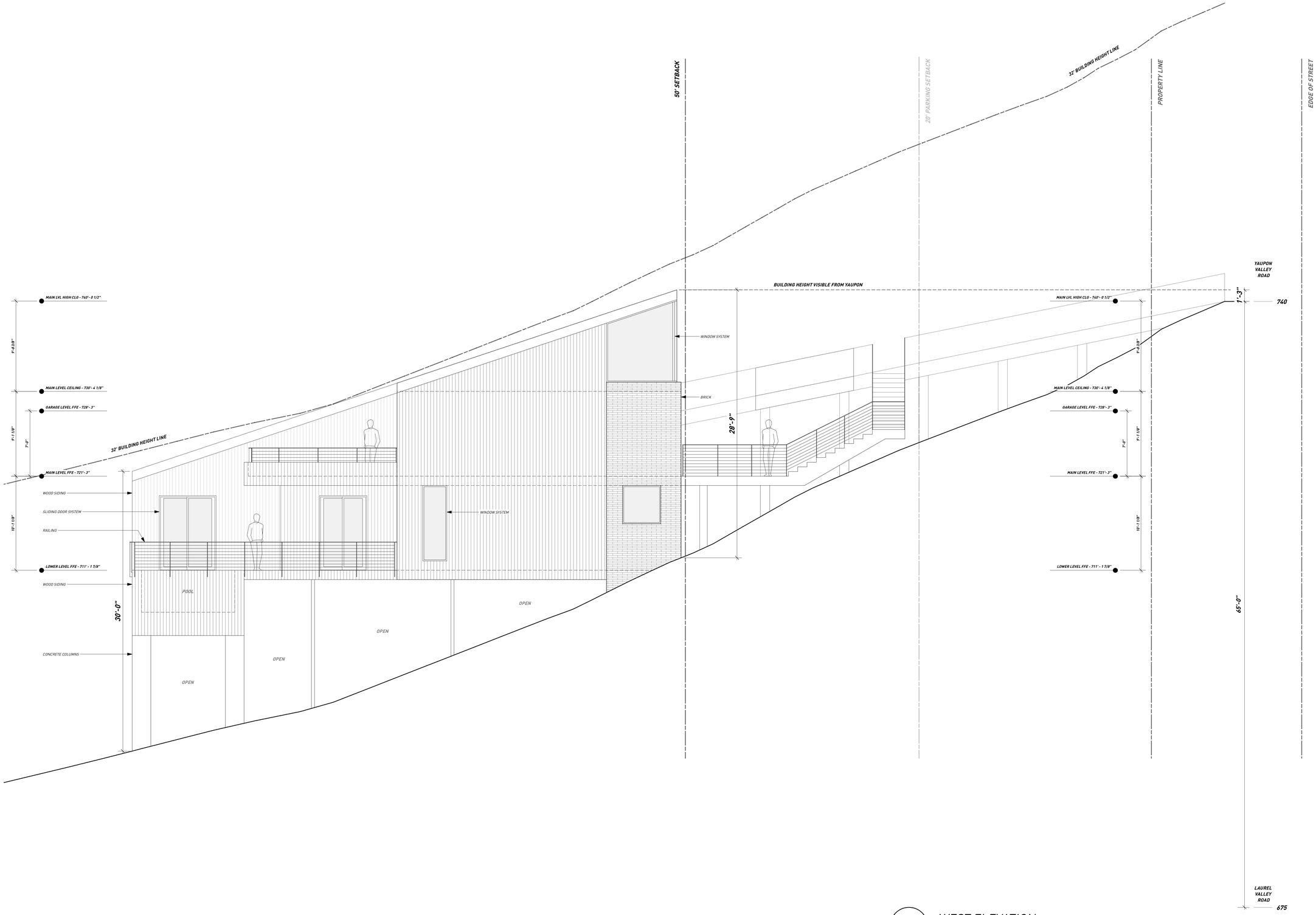
DATE ***MARCH 11 2026***

SHEET

8



1 WEST ELEVATION
1/4" = 1'-0"

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TITLE ELEVATIONS
DATE MARCH 11 2026
SHEET 9

From: Jim Mcbride
To: Planner
Subject: Variance request for 300 Laurel Valley
Date: Tuesday, January 6, 2026 12:07:11 PM

> You don't often get email from [redacted]. Learn why this is important

I write in opposition to the subject variance request.

Having recently constructed a new home we had to compromise to comply with city regulations. The scope and the magnitude of these variances strikes me as unprecedented. We redesigned our home because we encroached above the setback (ie our soffit) by 24". Having lived here now for two years I better appreciate the need for these regulations. Additionally drainage is a critical issue along Little Bee Creek.

Jim

Jim McBride
Blue Sage Capital
2700 Via Fortuna, Suite 300
Austin, TX. 78746
[redacted] | www.blue sage.com

From: Steve Brown
To: Joel Sherrouse; Jennifer Bills
Subject: Comments for Zapco Meeting, 18 Feb 2026 / 300 Block Laurel Valley
Date: Saturday, February 14, 2026 10:13:37 AM

You don't often get email from [redacted]. Learn why this is important

Hi Jennifer & Joel- I attended the last meeting in person but the window was cut short at the very end to speak. In the event I'm unable to attend in person this week, I may be traveling (but could try virtually), I would like this short email submitted in the building proposal and read out loud at the meeting. If you (or another member of the committee) are unable to perform this, please let me know.

Dear Members of the ZAPCO Commission and the West Lake Hills community,

I am writing regarding the property on the 300 block of Laurel Valley.

Like many in our community, I was deeply disappointed to see the extensive tree clearing on this lot. The natural canopy and screening are a defining part of why residents choose to live in West Lake Hills, and once mature trees are removed, they cannot simply be replaced in any meaningful timeframe. To date, no meaningful replanting has occurred that could begin restoring coverage or visual buffering.

It is also important to note that the site constraints cited in the variance requests were inherent to the lot at the time of purchase. Granting variances under these circumstances risks undermining the intent of our setback, height, and environmental protections — especially in this particular section of Laurel Valley and Yaupon Valley Roads, where homes already sit in close proximity and depend heavily on natural screening, particularly for neighbors across the canyon.

Unfortunately, the actions taken so far appear to move away from — rather than toward — the spirit of West Lake Hills' building and environmental standards.

Finally, Laurel Valley Road and Yaupon Valley Road are among the most actively walked, ridden, and enjoyed roads in our community. As stewards of this unique area, we should do everything possible to preserve the natural character, protections, and visual integrity that make West Lake Hills special for all residents.

Thank you for your time and consideration, and please include this comment in the public record for the February 18 meeting.

Sincerely,

Steve Brown

300 Cedar Oak Dr

From: Jane Noble <[redacted]
Sent: Friday, March 6, 2026 10:09 AM
To: James Vaughan <mayor@westlakehills.gov>; Dana Harmon <wlhcc1@westlakehills.gov>; Brian Plunkett <wlhcc2@westlakehills.gov>; Beth South <wlhcc3@westlakehills.gov>; Darin Walker <wlhcc4@westlakehills.gov>; Gordon Bowman <wlhcc5@westlakehills.gov>
Cc: Trey Fletcher <tfletcher@westlakehills.gov>
Subject: 309 Laurel Valley Road Variance requests

Some people who received this message don't often get email from [redacted] Learn why this is important

Dear Mayor and council members,

I am writing in opposition to all of the requested variances for the property at 309 Laurel Valley Road. I urge you to accept ZAPCO's recommendation to deny all the variances.

This is one of the most overreaching collections of variance requests I've ever seen. And I've seen a lot. This is a simple case of a commercial real estate developer trying to maximize profit by cramming way too much onto a less than one-half acre lot and trying to grab as much of a view as possible to entice potential buyers. I can't think of a single reason to grant any of these variance requests. This is a clearly buildable lot for the appropriate size house. The developer needs to build within the ordinances or sell and move on.

When you deny the variances, as I hope you will, please include in your motion, an instruction to staff to monitor any action on this lot **like hawks**. The developer has already flagrantly violated the ordinances and his own permit by "clear cutting" the lot hours after the city inspector left, apparently in preparation for the current outlandish plan — because the fines assessed by the city don't mean anything to a big guy real estate developer.

Thank you for your consideration of my concerns and for your service to our city.

Jane Noble
801 Yaupon Valley Road

Exhibit A

309 Laurel Valley Spiller Lane – Tree Timing Variance

Applicant's Findings of Fact

1. The strict or literal enforcement of the terms of this chapter, because of special conditions, will result in unnecessary hardship to the applicant.

   Literal enforcement of the requested code variances below will provide hardship to develop this project as-is and provide an unsafe driveway experience. I believe our requests are in line with the city's comprehensive plan goals and do not violate the intent of those goals. This is a modest project by size and scale and fits in with the neighboring houses in character and scale.

2. There will not be unreasonable disruption of the natural terrain or unreasonable destruction of existing flora.

   Due to the extreme, illegal clearing on this property, there is very little flora to work around. We did work around all existing trees at the top and bottom of the lot. There are even less trees now than shown on the most recent tree survey provided.

3. There is no reasonable alternative to the requisite variance that will alleviate the difficulty or hardship complained of.

   Please see requests 2, 3, 5 and 6.

4. The variance will not be greater than the minimum required to alleviate the difficulty or hardship complained of.

   The variances requested are at the minimum amount required and are not excessive or greater than the city's comprehensive plan goals. Please see requests 3 and 4.

5. The variance does not violate the intent of the Zoning Ordinance or goals of the Comprehensive Plan.

   Please reference requests 3 and 4.

6. The variance will not adversely affect neighboring properties or interfere with the enjoyment of these properties by their owners.

   Please reference request 4.

City *of* West Lake Hills
City Council

AGENDA REPORT

Meeting Date:	April 8, 2026	**Item Number:**	6
Department:	Building & Development Services		
Prepared By:	Jennifer C. Bills	**Cost / Budget:**	None
Exhibits:	See Attached	**Source of Funds:**	N/A

Subject

419 Ridgewood Trail: Discuss and consider action on a recommendation from ZAPCO on proposed variances for the removal of one tree (14.25-inch elm) with a trunk diameter of 14 inches or greater, (Section 22.03.304 of the West Lake Hills Code).

Applicant: Nina Falgout Sterrett, Arterberry Cooke Architecture

Recommendation

Hold a public hearing and determine the following findings of fact to approve or deny the requested variances.

1. The strict or literal enforcement of the terms of this chapter, because of special conditions, will result in unnecessary hardship to the applicant.
2. There will not be unreasonable disruption of the natural terrain or unreasonable destruction of existing flora.
3. There is no reasonable alternative to the requisite variance that will alleviate the difficulty or hardship complained of.
4. The variance will not be greater than the minimum required to alleviate the difficulty or hardship complained of.

The findings of fact as alleged by the applicant are attached in Exhibit A.

1. The variance may violate the intent of this chapter or the goals of the city's comprehensive plan.
2. The variance may have an adverse effect on neighborhood properties or interfere with the respective owners' enjoyment thereof.

The City Council can recommend imposition of reasonable conditions upon granting a variance if the conditions are related to the subject of the variance.

This item was reviewed by the Zoning and Planning Commission on March 18, 2026 and the following criteria used:

1. The variance may violate the intent of this chapter or the goals of the city's comprehensive plan; and
2. The variance may have an adverse effect on neighborhood properties or interfere with the respective owners' enjoyment thereof.

ZAPCO recommended **approval** of the variance 3-0 (Attachment 7).

Discussion

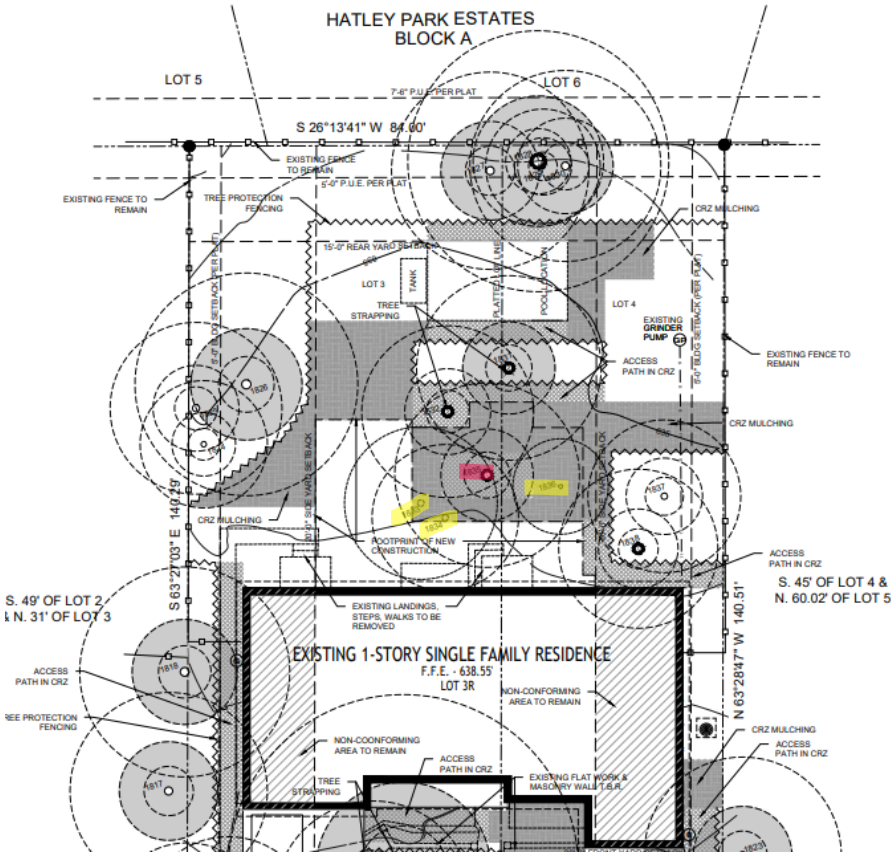
Property Information, Zoning & Site Characteristics:
Owner: Michelle & David Ewart
Legal Description: Lot 3R Ridgewood Village Section 2 Replat of portions of Lots 3 and 4
Lot Size: 0.2544 acres
Zoning: R-1
Wastewater: City Wastewater

The properties surrounding the subject property are zoned R-1, One-Family.

Background & Analysis:
The applicant is proposing to remove one 14.25" Elm tree in the backyard of their property (Attachment 1). In November 2025, a Remodel/Addition permit was approved which allowed the removal of three trees (Attachment 4) surrounding the 14.25" Elm. The proposed mitigation for the removed trees is shown to be placed around the permitter of the backyard property.
A letter from the owner's certified arborist (Attachment 5) details the tree to be in fair condition. The letter further details that until the approved tree removal permit, the tree had four other smaller Cedar Elm trees growing in close proximity and depended on each other structurally. According to the arborist, the removal of the surrounding trees opens-up more exposure to wind load, which could cause further stress to the compromised trunk.

The owners of the home installed cables to heal the tree after wind and ice caused a partial failure. The arborist states that the cables yielded some success, partially healing a wound in the tree.

The arborist states the tree has external defects, causing reasonable concern for the integrity of the internal structure of the trunk, affirming that the removal of the tree would relieve the owner's liability concerns.



TREE CHART

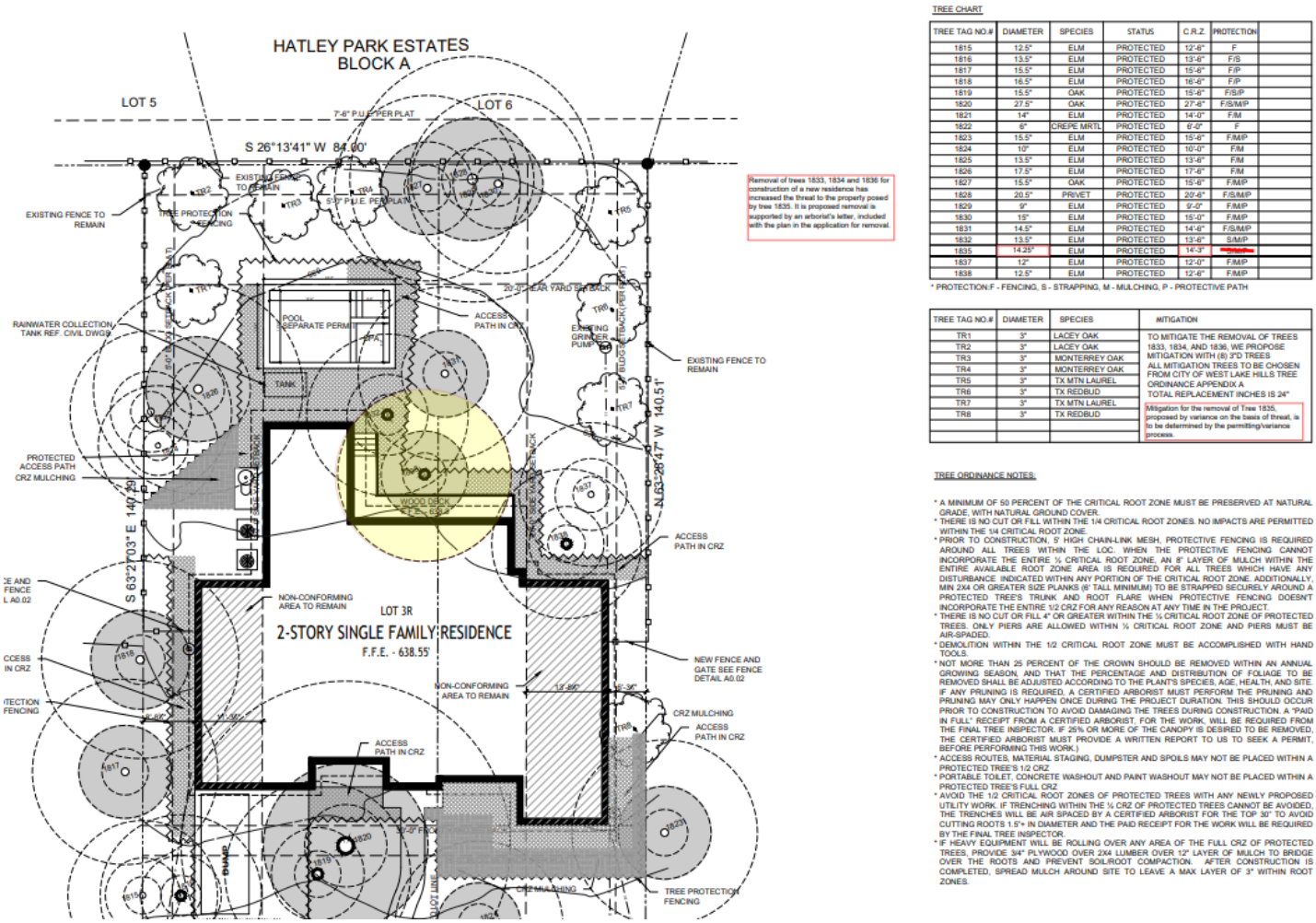
TREE TAG NO.#	LOCATION	DIAMETER	SPECIES	STATUS	C.R.Z.	PROTECTION	MITIGATION INCHES
1815	SETBACK	12.5"	ELM	PROTECTED	12'-6"	F	
1816	SETBACK	13.5"	ELM	PROTECTED	13'-6"	F/S	
1817	NEIGHBOR	15.5"	ELM	PROTECTED	15'-6"	F/P	
1818	NEIGHBOR	16.5"	ELM	PROTECTED	16'-6"	F/P	
1819	SETBACK	15.5"	OAK	PROTECTED	15'-6"	F/S/P	
1820	SETBACK	27.5"	OAK	PROTECTED	27'-6"	F/S/M/P	
1821	SETBACK	14"	ELM	PROTECTED	14'-0"	F/M	
1822	NEIGHBOR	6"	CREPE MRTL	PROTECTED	6'-0"	F	
1823	NEIGHBOR	15.5"	ELM	PROTECTED	15'-6"	F/M/P	
1824	SETBACK	10"	ELM	PROTECTED	10'-0"	F/M	
1825	SETBACK	13.5"	ELM	PROTECTED	13'-6"	F/M	
1826	SETBACK	17.5"	ELM	PROTECTED	17'-6"	F/M	
1827	SETBACK	15.5"	OAK	PROTECTED	15'-6"	F/M/P	
1828	SETBACK	20.5"	PRIVET	PROTECTED	20'-6"	F/S/M/P	
1829	SETBACK	9"	ELM	PROTECTED	9'-0"	F/M/P	
1830	SETBACK	15"	ELM	PROTECTED	15'-0"	F/M/P	
1831	CONST	14.5"	ELM	PROTECTED	14'-6"	F/S/M/P	
1832	CONST	13.5"	ELM	PROTECTED	13'-6"	S/M/P	
1833	CONST	12"	ELM	TO BE REMOVED	12'-0"		9"
1834	CONST	11.5"	ELM	TO BE REMOVED	11'-6"		8.75"
1835	CONST	14.5"	ELM	PROTECTED	14'-6"	S/M/P	
1836	CONST	7.5"	ELM	TO BE REMOVED	7'-6"		5.75"
1837	SETBACK	12"	ELM	PROTECTED	12'-0"	F/M/P	
1838	SETBACK	12.5"	ELM	PROTECTED	12'-6"	F/M/P	

* PROTECTION:F - FENCING, S - STRAPPING, M - MULCHING, P - PROTECTIVE PATH

TREE ORDINANCE NOTES:

* A MINIMUM OF 50 PERCENT OF THE CRITICAL ROOT ZONE MUST BE PRESERVED AT NATURAL GRADE, WITH NATURAL GROUND COVER.
* THERE IS NO CUT OR FILL WITHIN THE 1/4 CRITICAL ROOT ZONES. NO IMPACTS ARE PERMITTED WITHIN THE 1/4 CRITICAL ROOT ZONE.
* PRIOR TO CONSTRUCTION, 5' HIGH CHAIN-LINK MESH, PROTECTIVE FENCING IS REQUIRED AROUND ALL TREES WITHIN THE L.OC. WHEN THE PROTECTIVE FENCING CANNOT INCORPORATE THE ENTIRE ¼ CRITICAL ROOT ZONE, AN 8" LAYER OF MULCH WITHIN THE ENTIRE AVAILABLE ROOT ZONE AREA IS REQUIRED FOR ALL TREES WHICH HAVE ANY DISTURBANCE INDICATED WITHIN ANY PORTION OF THE CRITICAL ROOT ZONE. ADDITIONALLY, MIN 2X4 OR GREATER SIZE PLANKS (6' TALL MINIMUM) TO BE STRAPPED SECURELY AROUND A PROTECTED TREE'S TRUNK AND ROOT FLARE WHEN PROTECTIVE FENCING DOESN'T INCORPORATE THE ENTIRE 1/2 CRZ FOR ANY REASON AT ANY TIME IN THE PROJECT.
* THERE IS NO CUT OR FILL 4" OR GREATER WITHIN THE ½ CRITICAL ROOT ZONE OF PROTECTED TREES. ONLY PIERS ARE ALLOWED WITHIN ½ CRITICAL ROOT ZONE AND PIERS MUST BE AIR-SPADED.
* DEMOLITION WITHIN THE 1/2 CRITICAL ROOT ZONE MUST BE ACCOMPLISHED WITH HAND TOOLS.
* NOT MORE THAN 25 PERCENT OF THE CROWN SHOULD BE REMOVED WITHIN AN ANNUAL GROWING SEASON, AND THAT THE PERCENTAGE AND DISTRIBUTION OF FOLIAGE TO BE REMOVED SHALL BE ADJUSTED ACCORDING TO THE PLANT'S SPECIES, AGE, HEALTH, AND SITE. IF ANY PRUNING IS REQUIRED, A CERTIFIED ARBORIST MUST PERFORM THE PRUNING AND PRUNING MAY ONLY HAPPEN ONCE DURING THE PROJECT DURATION. THIS SHOULD OCCUR PRIOR TO CONSTRUCTION TO AVOID DAMAGING THE TREES DURING CONSTRUCTION. A "PAID IN FULL" RECEIPT FROM A CERTIFIED ARBORIST, FOR THE WORK, WILL BE REQUIRED FROM THE FINAL TREE INSPECTOR. IF 25% OR MORE OF THE CANOPY IS DESIRED TO BE REMOVED, THE CERTIFIED ARBORIST MUST PROVIDE A WRITTEN REPORT TO US TO SEEK A PERMIT, BEFORE PERFORMING THIS WORK.)
* ACCESS ROUTES, MATERIAL STAGING, DUMPSTER AND SPOILS MAY NOT BE PLACED WITHIN A PROTECTED TREE'S 1/2 CRZ
* PORTABLE TOILET, CONCRETE WASHOUT AND PAINT WASHOUT MAY NOT BE PLACED WITHIN A PROTECTED TREE'S FULL CRZ
* AVOID THE 1/2 CRITICAL ROOT ZONES OF PROTECTED TREES WITH ANY NEWLY PROPOSED UTILITY WORK. IF TRENCHING WITHIN THE ½ CRZ OF PROTECTED TREES CANNOT BE AVOIDED, THE TRENCHES WILL BE AIR SPACED BY A CERTIFIED ARBORIST FOR THE TOP 30" TO AVOID CUTTING ROOTS 1.5"+ IN DIAMETER AND THE PAID RECEIPT FOR THE WORK WILL BE REQUIRED BY THE FINAL TREE INSPECTOR.
* IF HEAVY EQUIPMENT WILL BE ROLLING OVER ANY AREA OF THE FULL CRZ OF PROTECTED TREES, PROVIDE 3/4" PLYWOOD OVER 2X4 LUMBER OVER 12" LAYER OF MULCH TO BRIDGE OVER THE ROOTS AND PREVENT SOIL/ROOT COMPACTION. AFTER CONSTRUCTION IS COMPLETED, SPREAD MULCH AROUND SITE TO LEAVE A MAX LAYER OF 3" WITHIN ROOT ZONES.

Existing Site Plan/Tree Survey (Attachment 6)



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1820	27.5"	OAK	PROTECTED	27'-6"	F/S/M/P	
1821	14"	ELM	PROTECTED	14'-0"	F/M	
1822	6"	CREPE MRTL	PROTECTED	6'-0"	F	
1823	15.5"	ELM	PROTECTED	15'-6"	F/M/P	
1824	10"	ELM	PROTECTED	10'-0"	F/M	
1825	13.5"	ELM	PROTECTED	13'-6"	F/M	
1826	17.5"	ELM	PROTECTED	17'-6"	F/M	
1827	15.5"	OAK	PROTECTED	15'-6"	F/M/P	
1828	20.5"	PRIVET	PROTECTED	20'-6"	F/S/M/P	
1829	9"	ELM	PROTECTED	9'-0"	F/M/P	
1830	16"	ELM	PROTECTED	16'-0"	F/M/P	
1831	14.5"	ELM	PROTECTED	14'-6"	F/S/M/P	
1832	13.5"	ELM	PROTECTED	13'-6"	S/M/P	
1835	14.25"	ELM	PROTECTED	14'-3"	[redacted]	
1837	12"	ELM	PROTECTED	12'-0"	F/M/P	
1838	12.5"	ELM	PROTECTED	12'-6"	F/M/P	

* PROTECTION:F - FENCING, S - STRAPPING, M - MULCHING, P - PROTECTIVE PATH

TREE TAG NO.#	DIAMETER	SPECIES	MITIGATION
TR1	3"	LACEY OAK	TO MITIGATE THE REMOVAL OF TREES 1833, 1834, AND 1836, WE PROPOSE MITIGATION WITH (8) 3"D TREES ALL MITIGATION TREES TO BE CHOSEN FROM CITY OF WEST LAKE HILLS TREE ORDINANCE APPENDIX A TOTAL REPLACEMENT INCHES IS 24"
TR2	3"	LACEY OAK	
TR3	3"	MONTERREY OAK	
TR4	3"	MONTERREY OAK	
TR5	3"	TX MTN LAUREL	
TR6	3"	TX REDBUD	
TR7	3"	TX MTN LAUREL	Mitigation for the removal of Tree 1835, proposed by variance on the basis of threat, is to be determined by the permitting/variance process.
TR8	3"	TX REDBUD	

TREE ORDINANCE NOTES:

* A MINIMUM OF 50 PERCENT OF THE CRITICAL ROOT ZONE MUST BE PRESERVED AT NATURAL GRADE, WITH NATURAL GROUND COVER.
* THERE IS NO CUT OR FILL WITHIN THE 1/4 CRITICAL ROOT ZONES. NO IMPACTS ARE PERMITTED WITHIN THE 1/4 CRITICAL ROOT ZONE.
* PRIOR TO CONSTRUCTION, 5' HIGH CHAIN-LINK MESH, PROTECTIVE FENCING IS REQUIRED AROUND ALL TREES WITHIN THE LOC. WHEN THE PROTECTIVE FENCING CANNOT INCORPORATE THE ENTIRE ½ CRITICAL ROOT ZONE, AN 8" LAYER OF MULCH WITHIN THE ENTIRE AVAILABLE ROOT ZONE AREA IS REQUIRED FOR ALL TREES WHICH HAVE ANY DISTURBANCE INDICATED WITHIN ANY PORTION OF THE CRITICAL ROOT ZONE. ADDITIONALLY, MIN 2X4 OR GREATER SIZE PLANKS (8' TALL MINIMUM) TO BE STRAPPED SECURELY AROUND A PROTECTED TREE'S TRUNK AND ROOT FLARE WHEN PROTECTIVE FENCING DOESN'T INCORPORATE THE ENTIRE 1/2 CRZ FOR ANY REASON AT ANY TIME IN THE PROJECT.
* THERE IS NO CUT OR FILL 4" OR GREATER WITHIN THE ¼ CRITICAL ROOT ZONE OF PROTECTED TREES. ONLY PIERS ARE ALLOWED WITHIN ¼ CRITICAL ROOT ZONE AND PIERS MUST BE AIR-SPADED.
* DEMOLITION WITHIN THE 1/2 CRITICAL ROOT ZONE MUST BE ACCOMPLISHED WITH HAND TOOLS.
* NOT MORE THAN 25 PERCENT OF THE CROWN SHOULD BE REMOVED WITHIN AN ANNUAL GROWING SEASON, AND THAT THE PERCENTAGE AND DISTRIBUTION OF FOLIAGE TO BE REMOVED SHALL BE ADJUSTED ACCORDING TO THE PLANT'S SPECIES, AGE, HEALTH, AND SITE. IF ANY PRUNING IS REQUIRED, A CERTIFIED ARBORIST MUST PERFORM THE PRUNING AND PRUNING MAY ONLY HAPPEN ONCE DURING THE PROJECT DURATION. THIS SHOULD OCCUR PRIOR TO CONSTRUCTION TO AVOID DAMAGING THE TREES DURING CONSTRUCTION. A "PAID IN FULL" RECEIPT FROM A CERTIFIED ARBORIST, FOR THE WORK, WILL BE REQUIRED FROM THE FINAL TREE INSPECTOR. IF 25% OR MORE OF THE CANOPY IS DESIRED TO BE REMOVED, THE CERTIFIED ARBORIST MUST PROVIDE A WRITTEN REPORT TO US TO SEEK A PERMIT, BEFORE PERFORMING THIS WORK.)
* ACCESS ROUTES, MATERIAL STAGING, DUMPSTER AND SPOILS MAY NOT BE PLACED WITHIN A PROTECTED TREE'S 1/2 CRZ.
* PORTABLE TOILET, CONCRETE WASHOUT AND PAINT WASHOUT MAY NOT BE PLACED WITHIN A PROTECTED TREE'S FULL CRZ.
* AVOID THE 1/2 CRITICAL ROOT ZONES OF PROTECTED TREES WITH ANY NEWLY PROPOSED UTILITY WORK. IF TRENCHING WITHIN THE ½ CRZ OF PROTECTED TREES CANNOT BE AVOIDED, THE TRENCHES WILL BE AIR SPACED BY A CERTIFIED ARBORIST FOR THE TOP 30" TO AVOID CUTTING ROOTS 1.5"+ IN DIAMETER AND THE PAID RECEIPT FOR THE WORK WILL BE REQUIRED BY THE FINAL TREE INSPECTOR.
* IF HEAVY EQUIPMENT WILL BE ROLLING OVER ANY AREA OF THE FULL CRZ OF PROTECTED TREES, PROVIDE 3/4" PLYWOOD OVER 2X4 LUMBER OVER 12" LAYER OF MULCH TO BRIDGE OVER THE ROOTS AND PREVENT SOIL/ROOT COMPACTION. AFTER CONSTRUCTION IS COMPLETED, SPREAD MULCH AROUND SITE TO LEAVE A MAX LAYER OF 3" WITHIN ROOT ZONES.

Proposed tree removal (Attachment 3)

Tree and vegetation removal and replacement

Code Reference:

Section 22.03.304(a)(4)

Removal policy.
(1) Existing vegetation shall be left undisturbed to the maximum extent possible. In most circumstances, if a tree must be removed, it shall be replaced with a native, non-invasive species so that the native, natural landscape of the city is preserved for future generations.

(2) Trees less than ten (10) inches in diameter measured at a point fifty-four (54) inches above the ground may be removed with a permit in accordance with section 22.03.303(b).

(3) Trees greater than or equal to ten (10) inches and less than fourteen (14) inches in diameter measured at a point fifty-four (54) inches above the ground may be removed with a permit in accordance with section

22.03.303(b)(4). If a tree greater than or equal to ten (10) inches and less than fourteen (14) inches in diameter does not meet the requirements of section 22.03.303(b)(4) then the removal shall be requested through a variance as described by subsection (a)(4) of this section.

(4) The removal of trees greater than or equal to fourteen (14) inches in diameter measured at a point fifty-four (54) inches above the ground, or a tree greater or equal to ten (10) inches and less than fourteen (14) inches in diameter that does not meet the requirements of section 22.03.303(b)(4), is prohibited except as allowed under section 22.03.303(b)(7) and therefore such removal requires a variance from the city council as outlined in section 22.03.308.

Request:
To remove a 14.25" elm tree.

Public Comments:
As of the date of the staff report, no written comments have been received. No comments were made at ZAPCO meeting.

Variance Criteria Review:
Trees follow the procedure and notice found in Section 22.03.511 Procedure and notice:

(a) The city council, when petitioned for a variance, after 16 days' written notice to all property owners within 300 feet of the subject property, shall hold a hearing, and the city council may vary the application of any provision of this article to any particular case when, in its opinion, the enforcement thereof would do manifest injustice, and would be contrary to the spirit and purpose of this article or public interest, or when, in its opinion, the interpretation and recommendation of the zoning and planning commission should be modified or reversed.

(b) A decision of the city council to vary the application of any provision of this article shall specify in what manner such variance is made, the conditions upon which it is made and the reasons thereof.

The criteria and process for granting a variance found in Section 22.03.514:

No variance shall be granted under this chapter unless the following criteria are fulfilled:

- Findings. The applicant has established by competent evidence that:
    - The strict or literal enforcement of the terms of this chapter, because of special conditions, will result in unnecessary hardship to the applicant.
    - There will not be unreasonable disruption of the natural terrain or unreasonable destruction of existing flora.
    - There is no reasonable alternative to the requisite variance that will alleviate the difficulty or hardship complained of.
    - The variance will not be greater than the minimum required to alleviate the difficulty or hardship complained of.
- ZAPCO. The recommendation of zoning and planning commission shall include an analysis of whether:

- The variance may violate the intent of this chapter or the goals of the city's comprehensive plan; and
- The variance may have an adverse effect on neighborhood properties, or interfere with the respective owners' enjoyment thereof; and
- When considering variance requests for nonresidential projects in the Commercial Overlay District, whether the variance, when considered as part of the proposed project (as a whole), furthers achievement of the land planning principles set forth in the city's master plan, attachment B, as codified in article 28.02 of this code.

- Conditions. The city council can impose, and the zoning and planning commission can recommend imposition of, reasonable conditions upon granting a variance if the conditions are related to the subject of the variance. When considering variance requests for nonresidential projects in the commercial overlay district are necessary to achieve one or more of the land planning principles set forth in the city's master plan, attachment B, as codified in article 28.02 of this code.

Outdoor Lighting

Outdoor lighting is not proposed with this variance request. Any outdoor lighting will need to comply with the City's Code.

Compliance with Adopted International Building Code

The property and future construction will have to comply with all applicable City codes.

Subdivision

There is no change to the subdivision proposed with this application.

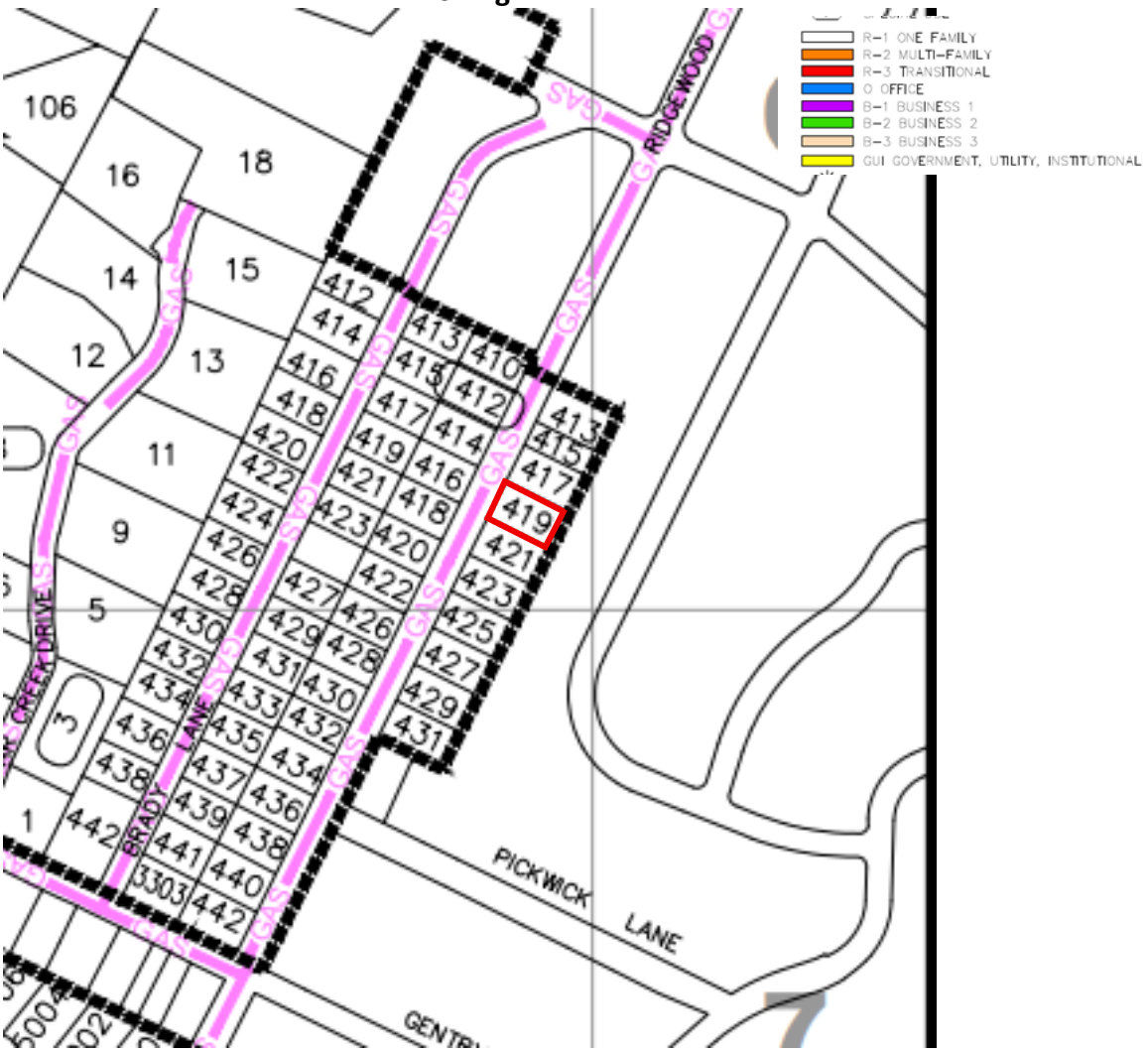
Comprehensive Planning Analysis

The existing and future land use is in conformance with the City of West Lake Hills Master Plan.

Links to Relevant Code:

- **Section 22.03.034 Tree and Vegetation Removal and Replacement**
- **Section 22.03.511 Variances**
- **Section 22.03.514 Criteria and process required for granting variance**

Zoning:


R-1 ONE FAMILY
R-2 MULTI-FAMILY
R-3 TRANSITIONAL
O OFFICE
B-1 BUSINESS 1
B-2 BUSINESS 2
B-3 BUSINESS 3
GUI GOVERNMENT, UTILITY, INSTITUTIONAL
RIDGEWOOD
PICKWICK LANE
BRADY LANE
CREEK DRIVE
106
16
18
14
15
12
13
11
9
5
3
1
419

Aerial:

366293
110721
110741
413
110749
110732
412
110720
110740
415
3223
110750
110733
419
110719
110739
RIDGEWOOD RD
Ridgewood Rd
PARK HILLS DR
110734
10718
110738
419
110751
21
110735
418
110767
110737
421
110752
3219
110736
Park PARKHILLS DR
422
107479
107499
107659
3216
107500
107480
107498
3215
107658
427
107497
563677
107655
107496

ARTERBERRY COOKE architecture

3411 Windsor Rd
Austin TX 78603

January 30, 2026

Re. Variance Request 419 Riddgewood Road

Dear Chairman Meisel and Members of the Zoning and Planning Commission,

The letter accompanies our application for variance for the property at 419 Ridgewood Road. We request your consideration to remove a protected tree on behalf of our client, the Owners, Michelle and David Ewart.

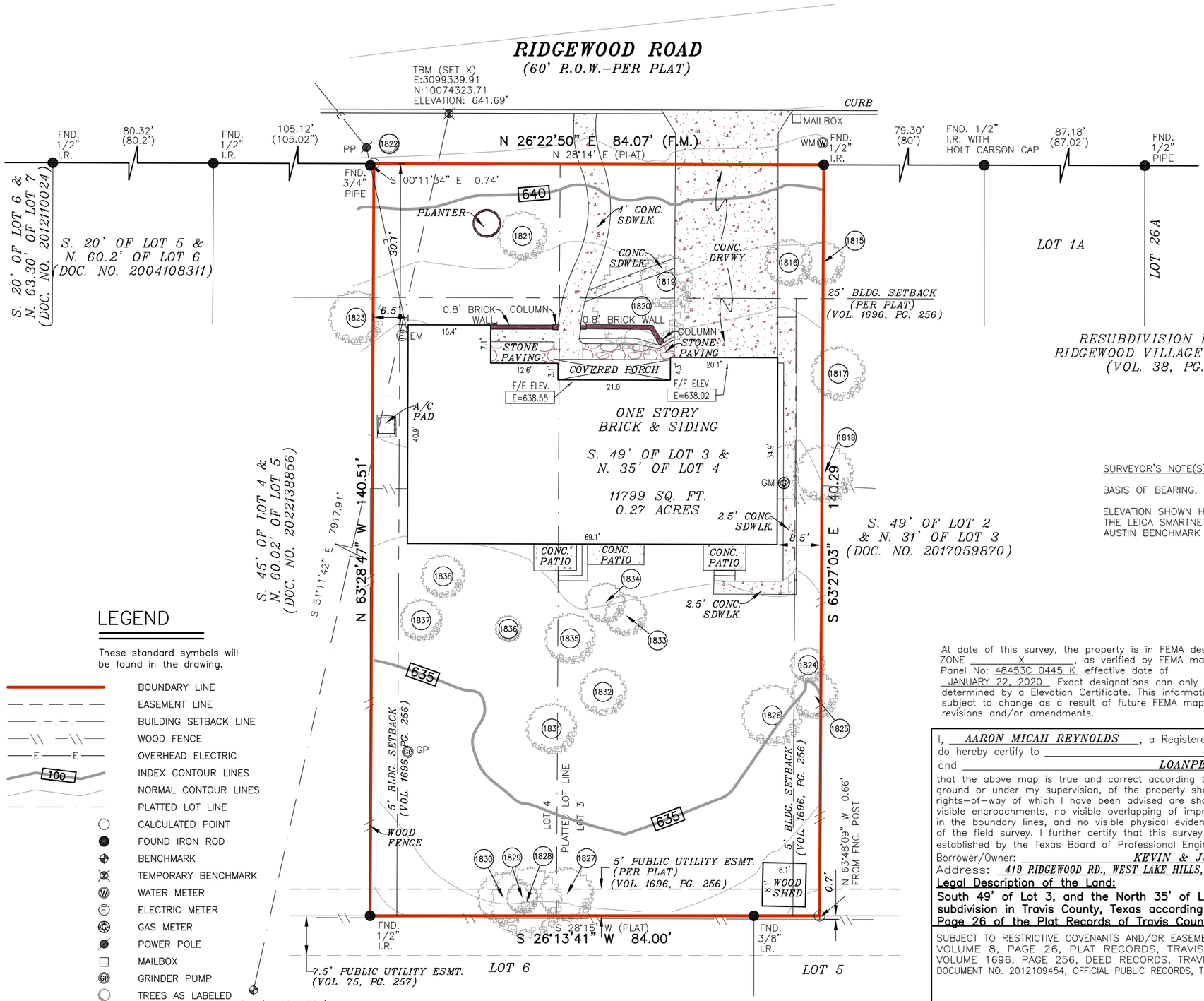
Remodel and additions to the residence at 419 Ridgewood Rd are underway. As part of this permitted project trees were removed at the center of the lot. The removed trees were supporting and protecting Tree 1835, a 14.25" cedar elm tree. This protected tree was to remain in place. However, after the removal of surrounding trees, it was clearly observed that the tree's structure and health are compromised. Additionally, it no longer has the support of the removed trees to rely on in wind and weather events. Given the tree's condition, the Owners believe Tree 1835 poses a threat to construction activities and to their future home. This belief is supported by the accompanying letter provided by Douglas Dear, Certified Arborist, who evaluated the tree onsite and presented his findings to city inspector Alex Sanchez.

As their architects we considered several development schemes for this site with attempts to preserve its character for the benefit of the homeowners, neighbors, and public domain. The approved plans assumed this tree would remain and provided for its protection from construction impacts. Ultimately, given the tree's history of incomplete repair, its proximity to construction activities and the proposed residence, it poses an ongoing hazard. It is not a good candidate for trimming or additional repair to stabilize it.

The removal of Tree 1835 will allow the Owners to mitigate ongoing liability concerns. They humbly request variance to remove and replace it as prescribed by code. The variance request seeks to protect construction activities, the Owners' investment, and neighboring properties from damage.

Sincerely

Alice Arterberry
Principal
Arterberry Cooke Architecture



TREE TAG NO.#	DIAMETER	DESCRIPTION
1815	12.5"	ELM
1816	13.5"	ELM
1817	15.5"	ELM
1818	16.5"	ELM
1819	15.5"	OAK
1820	27.5"	OAK
1821	14"	ELM
1822	6"	CREPE MYRTLE
1823	15.5"	ELM
1824	10"	ELM
1825	13.5"	ELM
1826	17.5"	ELM
1827	15.5"	OAK
1828	20.5"	PRIVET
1829	9"	ELM
1830	15"	ELM
1831	14.5"	ELM
1832	13.5"	ELM
1833	12"	ELM
1834	11.5"	ELM
1835	14.5"	ELM
1836	7.5"	ELM
1837	12"	ELM
1838	12.5"	ELM

SURVEYOR'S NOTE(S):

BASIS OF BEARING, TEXAS CENTRAL ZONE, NAD 83.

ELEVATION SHOWN HEREON ARE BASED ON GPS OBSERVATIONS USING THE LEICA SMARTNET RTK NETWORK AND REFERENCED TO THE CITY OF AUSTIN BENCHMARK AS SHOWN HEREON. VERTICLE DATUM: NAVD 88

LEGEND

These standard symbols will be found in the drawing.

- BOUNDARY LINE
- EASEMENT LINE
- BUILDING SETBACK LINE
- WOOD FENCE
- OVERHEAD ELECTRIC
- INDEX CONTOUR LINES
- NORMAL CONTOUR LINES
- PLATTED LOT LINE
- CALCULATED POINT
- FOUND IRON ROD
- BENCHMARK
- TEMPORARY BENCHMARK
- WATER METER
- ELECTRIC METER
- GAS METER
- POWER POLE
- MAILBOX
- GRINDER PUMP
- TREES AS LABELED
- (PLAT) RECORDED ON PLAT
- (F.M.) FIELD MEASURED

At date of this survey, the property is in FEMA designated ZONE X, as verified by FEMA map Panel No: 48453C 0445 K effective date of JANUARY 22, 2020. Exact designations can only be determined by a Elevation Certificate. This information is subject to change as a result of future FEMA map revisions and/or amendments.

The survey is hereby accepted with the discrepancies, conflicts, or shortages in area or boundary lines, encroachments, protrusions, or overlapping of Improvements shown.

X _____

X _____

GRAPHIC SCALE

0' 20' 40'

1 Inch = 20 Feet

I, AARON MICAH REYNOLDS, a Registered Professional Land Surveyor in the State of Texas, do hereby certify to CORRIDOR TITLE and LOANPEOPLE, LLC that the above map is true and correct according to an actual field survey, made by me on the ground or under my supervision, of the property shown hereon. I further certify that all easements and rights-of-way of which I have been advised are shown hereon and that, except as shown, there are no visible encroachments, no visible overlapping of improvements and no apparent discrepancies or conflicts in the boundary lines, and no visible physical evidence of easements or rights-of-way as of the date of the field survey. I further certify that this survey meets or exceeds the minimum standards established by the Texas Board of Professional Engineers and Land Surveyors (Section 138.89).

Borrower/Owner: KEVIN & JULIA HARTNETT TRUST

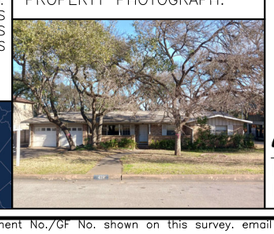
Address: 419 RIDGEWOOD RD., WEST LAKE HILLS, TX 78746 GF No. 24-0086-D

Legal Description of the Land:

South 49' of Lot 3, and the North 35' of Lot 4, of RIDGEWOOD VILLAGE, SEC. 2, a subdivision in Travis County, Texas according to the map or plat of record in Volume 8, Page 26 of the Plat Records of Travis County, Texas.

SUBJECT TO RESTRICTIVE COVENANTS AND/OR EASEMENTS RECORDED IN: VOLUME 8, PAGE 26, PLAT RECORDS, TRAVIS COUNTY, TEXAS VOLUME 1696, PAGE 256, DEED RECORDS, TRAVIS COUNTY, TEXAS DOCUMENT NO. 2012109454, OFFICIAL PUBLIC RECORDS, TRAVIS COUNTY, TEXAS

PROPERTY PHOTOGRAPH:



AMERISURVEYORS
EXCELLENCE IN LAND SURVEYING
P.O. BOX 160369
SAN ANTONIO, TEXAS 78280
PHONE: (210) 572 - 1995
WEB: WWW.AMERISURVEYORS.COM

"TREE" & "TOPOGRAPHY" SURVEY

JOB NO.:	2401098446	NO.	REVISION	DATE
DATE:	01/30/24			
DRAWN BY:	JD/UR/IM			
APPROVED BY:	AMR			

STATE OF TEXAS REGISTERED AARON MICAH REYNOLDS 6644 PROFESSIONAL LAND SURVEYOR

AARON MICAH REYNOLDS, R.P.L.S.
Registered Professional Land Surveyor
Registration No. 6644

Copyright © AmeriSurveyors LLC. FIRM REGISTRATION NUMBERS 10146400, 10193905. Improvements shown on this survey are for general illustration purposes only and may not portray exact shape and size. Survey is based on a Title report issued by the Title Company listed above issued under Commitment No./GF No. shown on this survey. email questions to: info@amerisurveyors.com

PROPOSED AREA CALCULATIONS

IMPERVIOUS COVER	
RESIDENCE	2,555 SQFT
ATTACHED GARAGE	538 SQFT
COVERED PORCH	78 SQFT
PERMEABLE DRIVEWAY (75%)	521 SQFT
WOOD DECK (50%)	74 SQFT
EQUIPMENT PADS/MISC FLATWORK	50 SQFT
SIDEWALK	168 SQFT
POOL	191 SQFT
SPA	36 SQFT
POOL COPING	81 SQFT
IMPERVIOUS COVER	4,292 SQFT

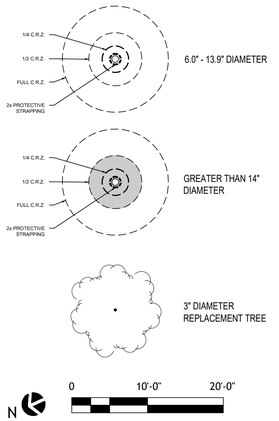
LOT AREA	11,798 SQFT
IMPERVIOUS COVER	4,292 SQFT
PERCENTAGE OF IC	36.4%
ALLOWABLE IC	36.5% (4306.27 SQFT)

CONDITIONED AREA	
FIRST FLOOR	2,555 SQFT
SECOND FLOOR	1,544 SQFT
TOTAL AREA	4,099 SQFT

LEGEND

- STAGING AREA
- ROOF OUTLINE
- SETBACK / EASEMENT
- PROPERTY LINE
- WOOD FENCING
- TREE PROTECTIVE FENCING
- DUMP — DUMPSTER / SPOILS
- WASHOUT(S)
- PT — PORTABLE TOILET
- SS — WASTE WATER
- GAS — GAS LINE
- W — WATER SUPPLY
- UE — UNDERGROUND ELEC
- P — OVERHEAD POWER
- PROTECTIVE MULCHING, SEE TREE NOTES
- 4'-0" WIDE ACCESS PATH WITHIN CRZ, SEE TREE NOTES
- W G E — WATER, GAS, POWER UTILITY METERS
- F.F.E. — FINISH FLOOR ELEVATION
- AIR CONDITIONER
- POOL EQUIPMENT

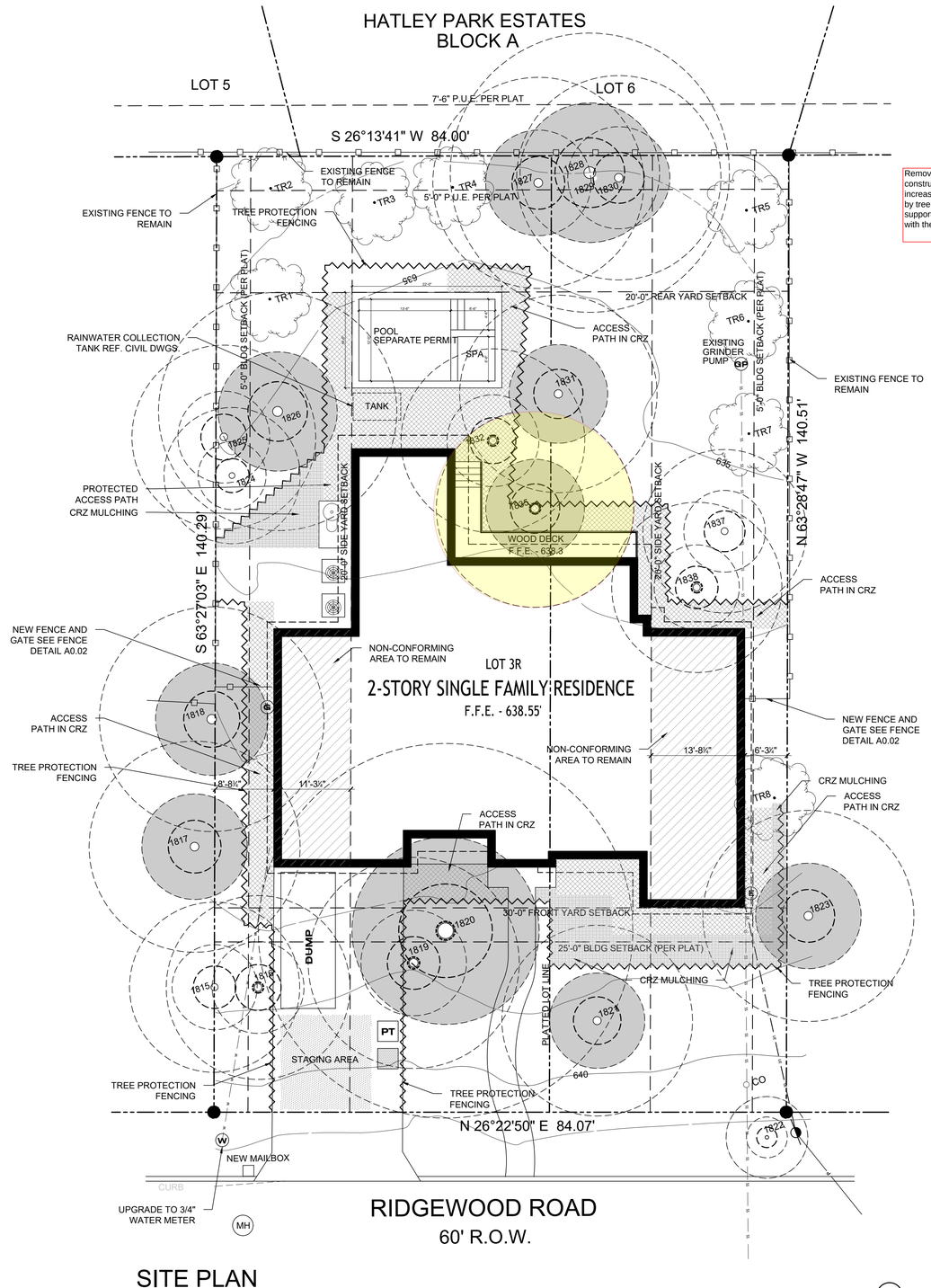
CRITICAL ROOT ZONES



N 0 10'-0" 20'-0"

NOTES:

- CONTRACTOR TO FIELD VERIFY LOCATION OF EXISTING UTILITIES
- PERMIT REQUIRED PRIOR TO REMOVAL OR PRUNING OF ANY TREE
- CONTRACTOR TO CALL FOR INSPECTION PRIOR TO REMOVAL OF ANY TREE OR BRANCH OF ANY SIZE FOR WHICH A PERMIT HAS NOT BEEN APPROVED FOR APPROVAL
- REFERENCE COWLH TREE NOTES FOR ADDITIONAL INFORMATION
- REFERENCE CIVIL DRAWINGS FOR EROSION AND SEDIMENTATION CONTROLS
- REFERENCE CIVIL DRAWINGS FOR IMPERVIOUS COVERAGE CALCULATIONS
- SEE TREE CHART FOR NEW TREES REQUIRED FOR MITIGATION OF TREE REMOVAL



SITE PLAN

Scale 1" = 10'-0" (TABLOID:Scale 1" = 20'-0") 1

Removal of trees 1833, 1834 and 1836 for construction of a new residence has increased the threat to the property posed by tree 1835. It is proposed removal is supported by an arborist's letter, included with the plan in the application for removal.

TREE CHART

TREE TAG NO.#	DIAMETER	SPECIES	STATUS	C.R.Z.	PROTECTION	
1815	12.5"	ELM	PROTECTED	12'-6"	F	
1816	13.5"	ELM	PROTECTED	13'-6"	F/S	
1817	15.5"	ELM	PROTECTED	15'-6"	F/P	
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* PRIOR TO CONSTRUCTION, 5' HIGH CHAIN-LINK MESH, PROTECTIVE FENCING IS REQUIRED AROUND ALL TREES WITHIN THE LOC. WHEN THE PROTECTIVE FENCING CANNOT INCORPORATE THE ENTIRE ½ CRITICAL ROOT ZONE, AN 8" LAYER OF MULCH WITHIN THE ENTIRE AVAILABLE ROOT ZONE AREA IS REQUIRED FOR ALL TREES WHICH HAVE ANY DISTURBANCE INDICATED WITHIN ANY PORTION OF THE CRITICAL ROOT ZONE. ADDITIONALLY, MIN 2X4 OR GREATER SIZE PLANKS (6' TALL MINIMUM) TO BE STRAPPED SECURELY AROUND A PROTECTED TREE'S TRUNK AND ROOT FLARE WHEN PROTECTIVE FENCING DOESN'T INCORPORATE THE ENTIRE 1/2 CRZ FOR ANY REASON AT ANY TIME IN THE PROJECT.
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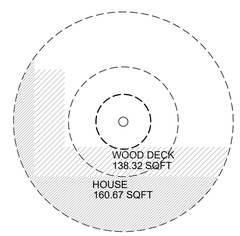
* PORTABLE TOILET, CONCRETE WASHOUT AND PAINT WASHOUT MAY NOT BE PLACED WITHIN A PROTECTED TREE'S FULL CRZ
* AVOID THE 1/2 CRITICAL ROOT ZONES OF PROTECTED TREES WITH ANY NEWLY PROPOSED UTILITY WORK. IF TRENCHING WITHIN THE ½ CRZ OF PROTECTED TREES CANNOT BE AVOIDED, THE TRENCHES WILL BE AIR SPACED BY A CERTIFIED ARBORIST FOR THE TOP 30" TO AVOID CUTTING ROOTS 1.5"+ IN DIAMETER AND THE PAID RECEIPT FOR THE WORK WILL BE REQUIRED BY THE FINAL TREE INSPECTOR.
* IF HEAVY EQUIPMENT WILL BE ROLLING OVER ANY AREA OF THE FULL CRZ OF PROTECTED TREES, PROVIDE 3/4" PLYWOOD OVER 2X4 LUMBER OVER 12" LAYER OF MULCH TO BRIDGE OVER THE ROOTS AND PREVENT SOIL/ROOT COMPACTION. AFTER CONSTRUCTION IS COMPLETED, SPREAD MULCH AROUND SITE TO LEAVE A MAX LAYER OF 3" WITHIN ROOT ZONES.

IMPACT DIAGRAM FOR TREE 1835:



FULL CRZ AREA: 660.52 SQFT
COVERAGE: 45.27% COVERAGE

Revisions By
#1 Permitting Update NFS
#2 Permitting Update NFS

ARTERBERRY COOKE architecture

Architect:
Alice Arterberry
3411 Windsor Rd
Austin, TX 78703
alice@arterberrycooke.com
323.236.5182

06/19/2025 REGISTERED ARCHITECT ALICE ARTERBERRY 26018 STATE OF TEXAS

Project Owner:
Michelle and David Ewart
3806 Meandering Creek Cv
Austin TX 78746

Project Address:
419 Ridgewood Rd
West Lake Hills 78746

Contractor:
Captex Construction

SITE PLAN

drawn by: MJS
checked by: NS
scale: 1" = 10'-0"
first issue: 06/19/2025
plot date: 11/19/2025

PERMIT SET

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PROPOSED AREA CALCULATIONS

IMPERVIOUS COVER	
RESIDENCE	2,555 SQFT
ATTACHED GARAGE	538 SQFT
COVERED PORCH	78 SQFT
PERMEABLE DRIVEWAY (75%)	521 SQFT
WOOD DECK (50%)	224 SQFT
EQUIPMENT PADS/MISC FLATWORK	104 SQFT
POOL	161 SQFT
SPA	36 SQFT
POOL COPING	78 SQFT
TOTAL AREAS	4,295 SQFT

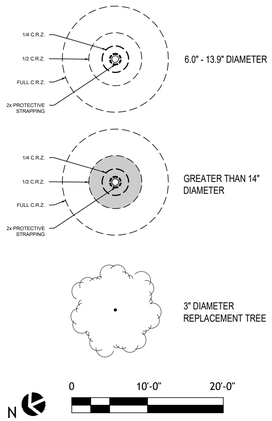
LOT AREA	11,798 SQFT
IMPERVIOUS COVER	4,295 SQFT
PERCENTAGE OF IC	36.4%
ALLOWABLE IC	36.5% (4306.27 SQFT)

CONDITIONED AREA	
FIRST FLOOR	2,555 SQFT
SECOND FLOOR	1,544 SQFT
TOTAL AREA	4,099 SQFT

LEGEND

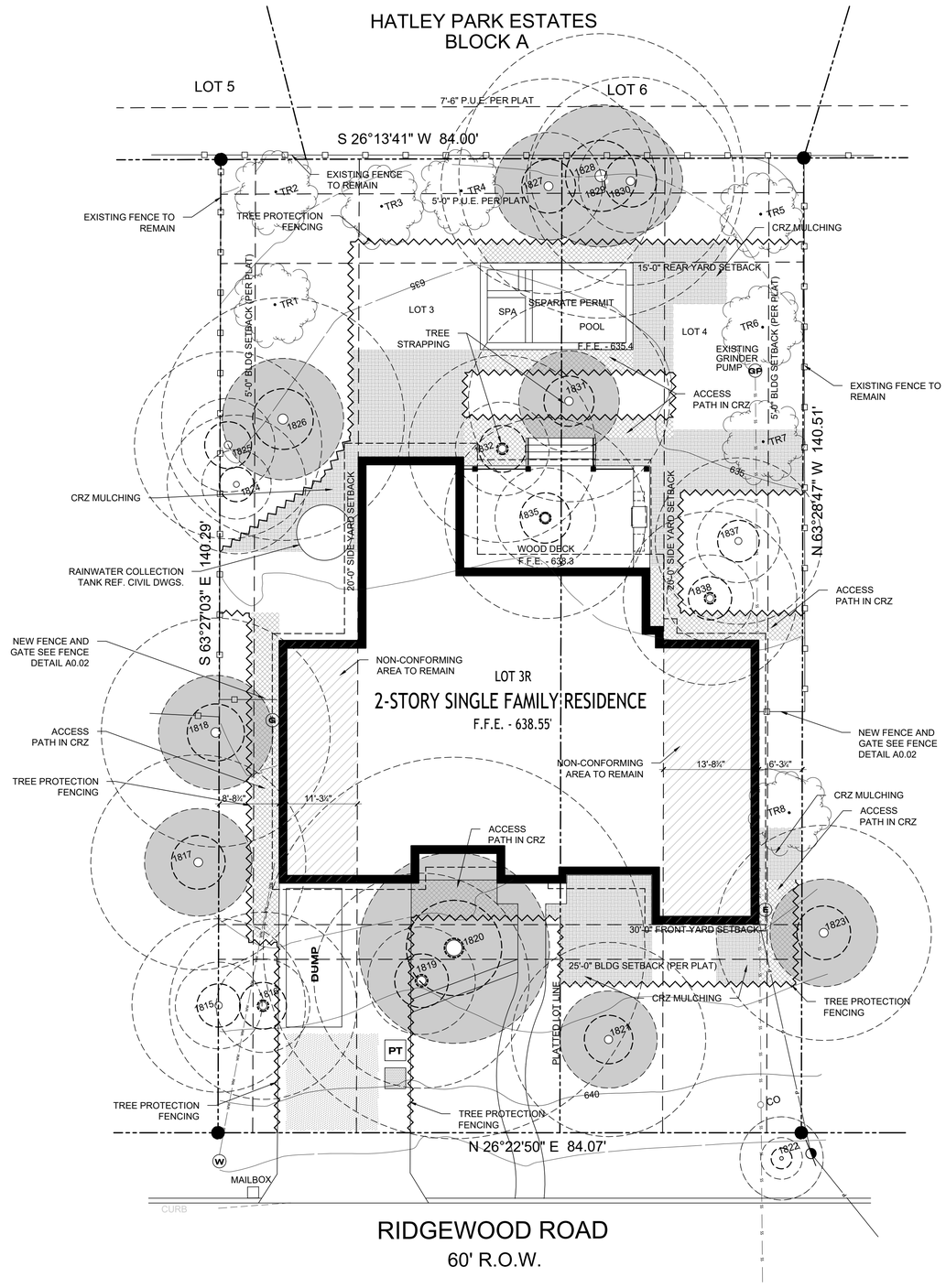
- STAGING AREA
- ROOF OUTLINE
- SETBACK / EASEMENT
- PROPERTY LINE
- WOOD FENCING
- TREE PROTECTIVE FENCING
- DUMP — DUMPSTER / SPOILS
- WASHOUT(S)
- PT — PORTABLE TOILET
- SS — WASTE WATER
- GAS — GAS LINE
- WW — WATER LINE
- UE — UNDERGROUND ELEC
- OVERHEAD POWER
- PROTECTIVE MULCHING
- 4'-0" WIDE ACCESS PATH WITHIN CRZ
- W G E — WATER, GAS, POWER UTILITY METERS
- F.F.E. — FINISH FLOOR ELEVATION
- AIR CONDITIONER
- POOL EQUIPMENT

CRITICAL ROOT ZONES



NOTES:

- CONTRACTOR TO FIELD VERIFY LOCATION OF EXISTING UTILITIES
- PERMIT REQUIRED PRIOR TO REMOVAL OR PRUNING OF ANY TREE
- CONTRACTOR TO CALL FOR INSPECTION PRIOR TO REMOVAL OF ANY TREE OR BRANCH OF ANY SIZE FOR WHICH A PERMIT HAS NOT BEEN APPROVED FOR APPROVAL
- REFERENCE COWLH TREE NOTES FOR ADDITIONAL INFORMATION
- REFERENCE CIVIL DRAWINGS FOR EROSION AND SEDIMENTATION CONTROLS
- SEE LANDSCAPE PLANS FOR NEW TREES REQUIRED FOR MITIGATION OF TREE REMOVAL
- REFERENCE CIVIL DRAWINGS FOR IMPERVIOUS COVERAGE CALCULATIONS



SITE PLAN

Scale 1" = 10'-0" (TABLOID:Scale 1" = 20'-0")

1

TREE CHART

TREE TAG NO.#	DIAMETER	SPECIES	STATUS	C.R.Z.	PROTECTION	
1815	12.5"	ELM	PROTECTED	12'-6"	F	
1816	13.5"	ELM	PROTECTED	13'-6"	F/S	
1817	15.5"	ELM	PROTECTED	15'-6"	F/P	
1818	16.5"	ELM	PROTECTED	16'-6"	F/P	
1819	15.5"	OAK	PROTECTED	15'-6"	F/S/P	
1820	27.5"	OAK	PROTECTED	27'-6"	F/S/M/P	
1821	14"	ELM	PROTECTED	14'-0"	F/M	
1822	6"	CREPE MRTL	PROTECTED	6'-0"	F	
1823	15.5"	ELM	PROTECTED	15'-6"	F/M/P	
1824	10"	ELM	PROTECTED	10'-0"	F/M	
1825	13.5"	ELM	PROTECTED	13'-6"	F/M	
1826	17.5"	ELM	PROTECTED	17'-6"	F/M	
1827	15.5"	OAK	PROTECTED	15'-6"	F/M/P	
1828	20.5"	PRIVET	PROTECTED	20'-6"	F/S/M/P	
1829	9"	ELM	PROTECTED	9'-0"	F/M/P	
1830	15"	ELM	PROTECTED	15'-0"	F/M/P	
1831	14.5"	ELM	PROTECTED	14'-6"	F/S/M/P	
1832	13.5"	ELM	PROTECTED	13'-6"	S/M/P	
1835	14.5"	ELM	PROTECTED	14'-6"	S/M/P	
1837	12"	ELM	PROTECTED	12'-0"	F/M/P	
1838	12.5"	ELM	PROTECTED	12'-6"	F/M/P	

* PROTECTION:F - FENCING, S - STRAPPING, M - MULCHING, P - PROTECTIVE PATH

TREE TAG NO.#	DIAMETER	SPECIES	MITIGATION
TR1	3"	TBD	TO MITIGATE THE REMOVAL OF TREES 1833, 1834, AND 1836, WE PROPOSE MITIGATION WITH (8) 3"D TREES ALL MITIGATION TREES TO BE CHOSEN FROM CITY OF WEST LAKE HILLS TREE ORDINANCE APPENDIX A. TOTAL REPLACEMENT INCHES IS 24"
TR2	3"	TBD	
TR3	3"	TBD	
TR4	3"	TBD	
TR5	3"	TBD	
TR6	3"	TBD	
TR7	3"	TBD	
TR8	3"	TBD	

TREE ORDINANCE NOTES:

* A MINIMUM OF 50 PERCENT OF THE CRITICAL ROOT ZONE MUST BE PRESERVED AT NATURAL GRADE, WITH NATURAL GROUND COVER.
* THERE IS NO CUT OR FILL WITHIN THE 1/4 CRITICAL ROOT ZONES. NO IMPACTS ARE PERMITTED WITHIN THE 1/4 CRITICAL ROOT ZONE.
* PRIOR TO CONSTRUCTION, 5' HIGH CHAIN-LINK MESH, PROTECTIVE FENCING IS REQUIRED AROUND ALL TREES WITHIN THE LOC. WHEN THE PROTECTIVE FENCING CANNOT INCORPORATE THE ENTIRE ½ CRITICAL ROOT ZONE, AN 8" LAYER OF MULCH WITHIN THE ENTIRE AVAILABLE ROOT ZONE AREA IS REQUIRED FOR ALL TREES WHICH HAVE ANY DISTURBANCE INDICATED WITHIN ANY PORTION OF THE CRITICAL ROOT ZONE. ADDITIONALLY, MIN 2X4 OR GREATER SIZE PLANKS (6' TALL MINIMUM) TO BE STRAPPED SECURELY AROUND A PROTECTED TREE'S TRUNK AND ROOT FLARE WHEN PROTECTIVE FENCING DOESN'T INCORPORATE THE ENTIRE 1/2 CRZ FOR ANY REASON AT ANY TIME IN THE PROJECT.
* THERE IS NO CUT OR FILL 4" OR GREATER WITHIN THE ½ CRITICAL ROOT ZONE OF PROTECTED TREES. ONLY PIERS ARE ALLOWED WITHIN ½ CRITICAL ROOT ZONE AND PIERS MUST BE AIR-SPADED.
* DEMOLITION WITHIN THE 1/2 CRITICAL ROOT ZONE MUST BE ACCOMPLISHED WITH HAND TOOLS.
* NOT MORE THAN 25 PERCENT OF THE CROWN SHOULD BE REMOVED WITHIN AN ANNUAL GROWING SEASON, AND THAT THE PERCENTAGE AND DISTRIBUTION OF FOLIAGE TO BE REMOVED SHALL BE ADJUSTED ACCORDING TO THE PLANT'S SPECIES, AGE, HEALTH, AND SITE. IF ANY PRUNING IS REQUIRED, A CERTIFIED ARBORIST MUST PERFORM THE PRUNING AND PRUNING MAY ONLY HAPPEN ONCE DURING THE PROJECT DURATION. THIS SHOULD OCCUR PRIOR TO CONSTRUCTION TO AVOID DAMAGING THE TREES DURING CONSTRUCTION. A "PAID IN FULL" RECEIPT FROM A CERTIFIED ARBORIST, FOR THE WORK, WILL BE REQUIRED FROM THE FINAL TREE INSPECTOR. IF 25% OR MORE OF THE CANOPY IS DESIRED TO BE REMOVED, THE CERTIFIED ARBORIST MUST PROVIDE A WRITTEN REPORT TO US TO SEEK A PERMIT, BEFORE PERFORMING THIS WORK.)
* ACCESS ROUTES, MATERIAL STAGING, DUMPSTER AND SPOILS MAY NOT BE PLACED WITHIN A PROTECTED TREE'S 1/2 CRZ
* PORTABLE TOILET, CONCRETE WASHOUT AND PAINT WASHOUT MAY NOT BE PLACED WITHIN A PROTECTED TREE'S FULL CRZ
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Revisions By

ARTERBERRY COOKE architecture

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alice@arterberrycooke.com
323.236.5182

REGISTERED ARCHITECT ALICE ARTERBERRY 06/19/2025 16014 STATE OF TEXAS

Project Owner:
Michelle and David Ewart
3806 Meandering Creek Cv
Austin TX 78746

Project Address:
419 Ridgewood Rd
West Lake Hills 78746

Contractor:
Captex Construction

SITE PLAN

drawn by: MJS
checked by: NS
scale: 1" = 10'-0"
first issue: 06/19/2025
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Mr. Ray Hannawell
Project Manager
Arterberry Cooke Architecture
3411 Windsor Road
Austin, Texas 78746
ray@arterberrycooke.com
512-771-9136

January 22, 2026
Sent via email

Project name: Home Remodel- Ewart Residence
Project address: 419 Ridgewood Road
West Lake Hills, Texas 78746
Scope of work: Tree Assessment-Cedar Elm #1835

Dear Mr. Hannawell,

On December 18, 2025**,** a site meeting was held to discuss Cedar Elm tree (#1835) located in the backyard.

Those in attendance were Building Inspector Alex Sanchez, Ray Hannawell, Project Superintendent Daniel Prosise from Cap Tex Construction and myself.
The existing structural defects and health condition of the tree were discussed. The tree was re-measured and I confirmed the measurement to be 14.25" diameter at breast height (dbh). I also pointed out to Inspector Sanchez the tree is now vulnerable to increased "Wind Load" that wasn't there before the adjacent trees were removed, with Permit. Inspector Sanchez suggested the best path forward, would be a Variance request, submitted to the City of West Lake Hills for review. A Tree Assessment from the Certified Arborist would also need to accompany the submittal.

On December 22nd I conducted a tree assessment for tree #1835, a Cedar Elm located in the center of the backyard**.**
My scope of work, included walking the site, measuring the tree, reviewing the tree structure, observing the critical root zone and tree health. I also photographed the tree and surroundings.

Conditions on site include: (see pictures below)

1. The Cedar Elm (#1835) is located in the center of the backyard of the existing home. It has been previously reviewed and permitted to remain to co-exist with the new home remodel and pool.
2. The tree is in "Fair" health with a slender structure commonly found when multiple trees are growing close together. The canopy is viable but slight in leaf volume, typical of closely clustered, growing trees. The tree size measures 14-1/4" diameter at breast height (dbh) and calculates to have a full Critical Root Zone of 14'-3" and a half Critical root zone of 7'-1-1/2". The tree has co-dominate central trunk leaders that occur approximately 22' above natural grade. Until recently, this tree had four other, smaller Cedar Elm trees growing in close proximity with one another. These trees were of the same species and depended on each other structurally.
3. **Contributing factors:** This tree structure displays a partial failure in the past (likely from wind or ice storm damage 4-5 years previous). The partial failure consists of a four-foot long, shear crack, split down the trunk and is very evident just below the co-dominant stem connection. After that storm event the previous property owners elected to have the co-dominate stems "Cabled" together, versus removing the tree. The single cable did allow for the tree to "Partially heal-up" but an open wound / cavity, still exists in the main tree trunk. At the time of that weather event, the tree was likely not as tall and with help from the adjacent trees, the wind stress was less, this allowed the "Cable" technique some success.
4. The adjacent trees closest to #1835 have been removed with Permit and this opens-up more exposure to "Wind Load" for this tree's canopy, magnifying the stress on the compromised trunk structure.

Tree # 1835 Slender shape and canopy

Tree # 1835 14.25" Cedar Elm with co-dominant trunk leaders

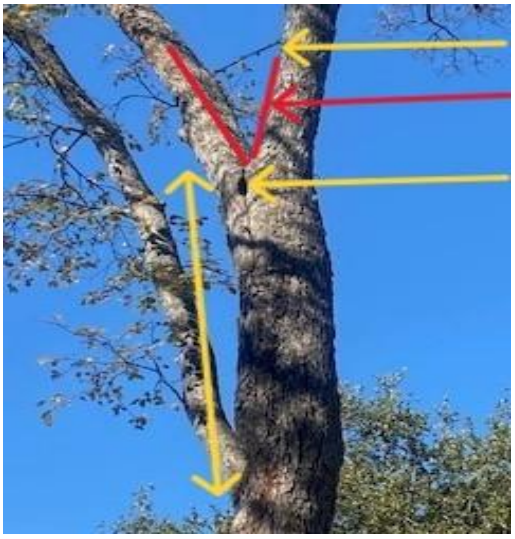
Tree # 1835

Previously installed cable location.

Co-dominant trunk leaders

Shear crack approximately 4 feet in length (in yellow).

Co-dominant trunk condition begins approximately 22' above grade.(shown in white).



Previously installed cable and location.

"V" shaped, co-dominant trunk leader (indicated by red lines).

"Open hole" in "Shear Crack" leading to interior cavity.

"Shear Crack" from previous storm damage approximately 4 feet in length, (indicated by yellow arrow).

Assessment summary:

This Cedar Elm (#1835) is viable but has visible internal and external defects. With these external defects there is reasonable cause and concern for the integrity of the internal trunk structure of the tree. The tree has multiple "Targets" including the new house, exterior stairs, walkway and pool area that will be affected if a weather event presents conditions that could cause the tree to fail. The tree is not a good candidate for monitoring or management because tree health and structural improvement cannot be quantified.
The property owner's liability concerns are valid and it is my conclusion that removal of the tree will be the best way to mitigate their liability concerns

This concludes my assessment.

Certified Arbor Care is available to assist with all your tree care and removal needs. This includes Remedial Tree Care, tree removals, pruning, stump grinding, root zone air-spading, tree limb pruning, root pruning and fertilizations.

Thank you for the opportunity to assist you with this Project.

Sincerely,

Douglas Land Dear, ASLA
Landscape Architect TX #1838
ISA Certified Arborist TX #3919
ISA Tree Risk Assessment Qualified, Arborist
Texas ISA Oak Wilt Qualified, Arborist TX-216
Texas ISA Wildfire Risk Reduction Qualified, Arborist TX-120
TCEQ Licensed Irrigator LI #5131
512-818-5840

GENERAL NOTES

CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ALL WORK AND MATERIALS IN CONFORMANCE WITH ALL CODE(S) AND GUIDELINES OF FEDERAL, STATE, COUNTY AND MUNICIPALITY HAVING JURISDICTION. ALL APPLICABLE REQUIREMENTS IN THESE REGULATIONS SHALL BE FOLLOWED THE SAME AS IF NOTED ON THE DRAWINGS, INCLUDING:

2015 INTERNATIONAL RESIDENTIAL CODE, 2015 INTERNATIONAL FIRE CODE, 2015 INTERNATIONAL ENERGY CONSERVATION CODE, 2015 INTERNATIONAL PLUMBING CODE, 2015 INTERNATIONAL MECHANICAL CODE, AND 2017 NATIONAL ELECTRICAL CODE WITH STATE AND LOCAL AMENDMENTS AS ADOPTED BY THE LOCAL JURISDICTION.

IF THE CONTRACTOR ASCERTAINS AT ANY TIME THAT REQUIREMENTS OF THIS CONTRACT CONFLICTS WITH, OR ARE IN VIOLATION OF, APPLICABLE LAWS, CODES, REGULATIONS AND ORDINANCES, HE SHALL NOT PROCEED WITH WORK IN QUESTION, EXCEPT AT HIS OWN RISK, UNTIL ARCHITECT HAS BEEN NOTIFIED IN WRITING AND WRITTEN DETERMINATION IS MADE BY ARCHITECT. WHERE COMPLETED OR PARTIALLY COMPLETED WORK IS DISCOVERED TO BE IN VIOLATION WITH APPLICABLE LAWS, CODES, REGULATIONS AND/OR ORDINANCES, THE CONTRACTOR SHALL BE REQUIRED TO REMOVE THAT WORK FROM THE PROJECT AND REPLACE WITH ALL NEW COMPLYING WORK AT NO ADDITIONAL COST TO OWNER.

CONTRACTOR SHALL PROVIDE PUBLIC PROTECTION AS REQUIRED PER GOVERNING AGENCY AND CODE REQUIREMENTS. CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLING ANY TEMPORARY SHORING AND BRACING TO INSURE THE SAFETY OF THE WORK.

THE CONTRACTOR SHALL COORDINATE ALL REQUIREMENTS OF THE AUTHORITIES HAVING JURISDICTION FOR SIDEWALKS, DRIVEWAYS, CURBS, GUTTERS, STREETLIGHTS, EASEMENTS, UTILITIES, FENCES, SIGNS, BARRICADES, ETC. ADJACENT TO THE PROPERTY, AND SHALL OBTAIN ALL NECESSARY PERMITS AND APPROVALS.

CONTRACTOR SHALL COORDINATE ALL MECHANICAL, PLUMBING, ELECTRICAL, AND ARCHITECTURAL WORK.

WHERE WORK OR EQUIPMENT IS INDICATED N.I.C. SUCH WORK AND OR EQUIPMENT SHALL BE PROVIDED BY OTHERS. CONTRACTOR SHALL COORDINATE AND COOPERATE TO EFFECT SUCH INSTALLATION.

INFORMATION CONTAINED IN THESE DOCUMENTS WHICH DESCRIBE OR LOCATE EXISTING SITE AND BUILT ELEMENTS, IS BASED ON INFORMATION (DRAWINGS, NOTES, SURVEYS, ETC.) SUPPLIED BY THE OWNER AND/OR HIS ARCHITECTS, AND LIMITED SITE OBSERVATION. THE CONTRACTOR/OWNER'S SUBCONTRACTORS SHALL VERIFY ALL DIMENSIONS AND FINISH CONDITIONS APPLICABLE TO THE WORK DESCRIBED HEREIN.

THE CONTRACTOR IS TO SURVEY EXISTING SITE CONDITIONS AS REQUIRED FOR COORDINATION WITH EXISTING UTILITIES AND THEIR CONNECTIONS. WHERE DISCREPANCIES ARE FOUND, THE CONTRACTOR SHALL ADVISE THE OWNER AND THE ARCHITECT.
THE CONTRACTOR SHALL TAKE PROTECTION MEASURES THAT WILL BE UTILIZED DURING CONSTRUCTION TO PROTECT ADJOINING AND NEARBY PROPERTIES (PUBLIC AND PRIVATE) FROM NOISE, DUST, DIRT, FIRE HAZARDS AND POTENTIAL PROBLEMS CAUSED BY SUCH CONSTRUCTIONS.

PROPERTY AND PREMISE LINES ADJACENT TO THE BUILDING SHALL BE ESTABLISHED IN THE FIELD BY A LICENSED SURVEYOR AND A SURVEY REPORT SHALL BE AVAILABLE ON SITE PRIOR TO FOUNDATION INSPECTION.

FUTURE OWNER IMPROVEMENTS REQUIRE SEPARATE BUILDING PERMITS.

THIS DOCUMENT, THE IDEAS, AND THE DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF THE ARCHITECT AND IS NOT TO BE USED IN WHOLE OR IN PART, FOR ANY PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF THE ARCHITECT.

LARGER SCALE DRAWINGS SHALL HAVE PRECEDENCE OVER THOSE OF SMALLER SCALE. WHERE DISCREPANCIES ARE FOUND BETWEEN THE ARCHITECTURAL DRAWINGS AND THOSE OF OTHER CONSULTANTS, THE ARCHITECTURAL DRAWINGS SHALL GENERALLY BE ASSUMED TO GOVERN.

DIMENSIONS SHALL HAVE PREFERENCE OVER SCALE.

DIMENSIONS ARE TO FACE OF STUD FRAMING MEMBERS OR EXTERIOR FINISHED SURFACES ON NEW CONSTRUCTION. DIMENSIONS ARE FROM FACE OF FINISH SURFACE TO FACE OF FINISH SURFACE ON EXISTING CONSTRUCTION, UNLESS OTHERWISE NOTED.

THE ARCHITECT HEREBY STATES THAT SHE HAS NO KNOWLEDGE OF ANY POSSIBLE EXISTENCE OF HAZARDOUS MATERIALS AT THIS SITE AND THAT SHE CANNOT AND WILL NOT BE HELD LIABLE FOR ANY UNSEEN OR UNKNOWN HAZARDOUS MATERIAL RELATED CONDITIONS THAT MAY ARISE DURING THE WORK. IF SUCH CONDITIONS SHOULD BE DISCOVERED THE CONTRACTOR SHALL STOP ALL WORK IMMEDIATELY AND NOTIFY THE OWNER OF SUCH. THE OWNER SHALL BE RESPONSIBLE FOR MAKING ARRANGEMENTS FOR THE SAFE AND LEGAL REMOVAL OF HAZARDOUS MATERIAL AND REMEDYING ANY HAZARDOUS CONDITIONS AS REQUIRED BY THE GOVERNING AUTHORITIES. THE CONTRACTOR SHALL NOT BE EXPECTED TO RESUME WORK UNTIL SUCH REMOVALS ARE EFFECTED IN A SAFE AND LEGAL MANNER.

DETAILS NOT SHOWN ARE TO BE SIMILAR IN CHARACTER TO THOSE DETAILED. WHERE SPECIFIC DIMENSIONS, DETAILS OR DESIGN INTENT CANNOT BE DETERMINED, OBTAIN CLARIFICATION FROM THE ARCHITECT BEFORE PROCEEDING WITH THE WORK.

ALL DRAWINGS AND NOTES ARE COMPLEMENTARY, AND WHAT IS CALLED FOR BY ANY ONE WILL BE AS BINDING AS IF CALLED FOR BY ALL.
SUBSTITUTION OF ACCEPTABLE EQUIVALENTS WILL BE PERMITTED AS APPROVED BY THE ARCHITECT AND/OR OWNER

ALL INSULATING MATERIAL SHALL COMPLY WITH THE FLAME SPREAD AND SMOKE DENSITY REQUIREMENTS OF THE 1997 UNIFORM BUILDING CODE.
DISSIMILAR METALS SHALL BE EFFECTIVELY ISOLATED FROM EACH OTHER TO PREVENT GALVANIC ACTION.

IN NEW CONSTRUCTION SMOKE DETECTORS SHALL RECEIVE THEIR PRIMARY POWER SOURCE FROM THE BUILDING WIRING AND SHALL BE EQUIPPED WITH BATTERY BACK UP AND LOW BATTERY SIGNAL. SMOKE DETECTORS SHALL BE LOCATED IN EACH SLEEPING ROOM & HALLWAY OR AREA GIVING ACCESS TO A SLEEPING ROOM, AND ON EACH STORY AND BASEMENT FOR DWELLINGS WITH MORE THAN ONE STORY.

PROVIDE CARBON MONOXIDE ALARM OUTSIDE EACH SLEEPING AREA

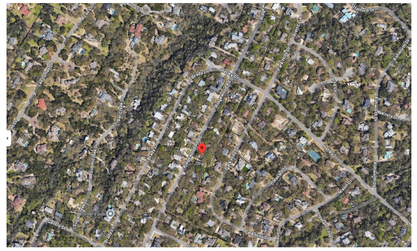
PLUMBING FIXTURES ARE REQUIRED TO BE CONNECTED TO SANITARY SEWER.KITCHEN SINKS, LAVS, BATHTUBS, SHOWERS, BIDETS, LAUNDRY TUBS, AND WASHING MACHINE OUTLETS SHALL BE PROVIDED WITH HOT AND COLD WATER AND CONNECTED TO APPROVED WATER SUPPLY.

EXTEND THROUGH ROOF FLUES AND VENTS UP THROUGH ROOF IN ACCORDANCE WITH THE IRC TO ACHIEVE REQUIRED CLEARANCES. FLASH AND SEAL ALL ROOF PENETRATIONS.

NEWLY INSTALLED BATHROOM EXHAUST FANS SHALL BE ENERGY STAR AND SHALL TERMINATE OUTSIDE THE BUILDING.

PROVIDE EMERGENCY EGRESS FROM SLEEPING ROOMS. MIN 24" CLEAR HT, 20" CLEAR WIDTH, 5.7 SQFT AND 44" MAX TO SILL)

PROVIDE SOLID BLOCKING WITHIN WALLS FOR ALL MILLWORK, WALL HUNG ACCESSORIES, TV, AND EQUIPMENT. PROVIDE BLOCKING IN CEILINGS AT ALL HEAVY PENDANT AND CEILING FANS. FIELD VERIFY AND COORDINATE ALL REQUIRED BLOCKING.



VICINITY MAP
SCALE : N.T.S.

SCOPE OF WORK
RENOVATION AND SECOND FLOOR ADDITION TO EXISTING SINGLE FAMILY RESIDENCE AND RELATED SITE DEVELOPMENT

SYMBOL LEGEND

- REVISION TAG
- WALL TYPE TAG
- DOOR TAG
- WINDOW TAG
- EXTERIOR ELEVATION TAG
- INTERIOR ELEVATION TAG (TP, LF, RT, BT)
- BUILDING SECTION TAG
- DETAIL TAG

DRAWING INDEX

A0.0	COVER	A3.4	EDGE OF SLAB PLAN
A0.01	ESCP, TREE PROTECTION	A3.5	ROOF PLAN
A0.02	CoWLH GENERAL NOTES	A4.0	EXTERIOR ELEVATIONS
A0.1	WALL TYPES	A4.1	EXTERIOR ELEVATIONS
A0.2	WINDOW TYPES	A5.0	BUILDING SECTIONS
A0.3	DOOR TYPES	A5.1	BUILDING SECTIONS
A0.4	DOOR & WINDOW DETAILS	A5.2	BUILDING SECTIONS
A1.0	SITE DEMOLITION PLAN	A6.0	WALL SECTIONS
A1.1	SITE PLAN	A6.1	WALL SECTIONS
A1.2	SITE LIGHTING PLAN	A6.2	WALL SECTIONS
A2.0	1ST FLOOR DEMOLITION PLAN	A6.3	WALL SECTIONS
A2.1	ROOF DEMOLITION PLAN	E1.0	1ST FLOOR ELECTRICAL PLAN
A3.0	1ST FLOOR PLAN - NOTES	E1.1	2ND FLOOR ELECTRICAL PLAN
A3.1	1ST FLOOR PLAN - DIMENSIONS	E2.0	1ST FLOOR REFLECTED CEILING PLAN
A3.2	2ND FLOOR PLAN - NOTES	E2.1	2ND FLOOR REFLECTED CEILING PLAN
A3.3	2ND FLOOR PLAN - DIMENSIONS		

PROJECT INFORMATION

ADDRESS
419 RIDGEWOOD RD
WEST LAKE HILLS, TX 78746

LEGAL DESCRIPTION
REPLAT OF S. 49' OF LOT 3 & N. 35' OF LOT 4 RIDGEWOOD VILLAGE SEC. 2 SUBDIVISION
0.27 ACRES OUT OF THE HENRY P HILL SUVEY N0.21, ABSTRACT NUMBER 14

ZONING
R-1 ONE-FAMILY

LOT AREA
11,798 SQFT
0.271 ACRES

PROJECT SQUARE FOOTAGES:

LOT:	11,798 SQFT
FIRST FLOOR:	2,555 SQFT
SECOND FLOOR:	1,544 SQFT
GARAGE:	538 SQFT
COVERED FRONT PORCH:	78 SQFT
WOOD DECK:	448 SQFT

DEVELOPMENT REGULATION

MAX HEIGHT:	30 FT
FRONT SETBACK:	30 FT
REAR SETBACK:	15 FT
SIDE SETBACK:	20 FT
IMPERVIOUS AREA:	36.5% ALLOWABLE

BRIEF SPECIFICATION

EXECUTION AND CLOSEOUT REQUIREMENTS - THE EXECUTION OF ALL WORK SHALL BE IN STRICT ACCORDANCE WITH THESE SPECIFICATIONS AND MANUFACTURER'S WRITTEN SPECIFICATIONS OR MATERIAL'S INSTITUTE STANDARDS. CONTRACTOR TO INVESTIGATE PROPOSED PRODUCT SUBSTITUTIONS AND DETERMINE THAT THEY ARE EQUAL OR SUPERIOR IN ALL RESPECTS TO PRODUCTS SPECIFIED. COORDINATE INSTALLATION OF ACCEPTED SUBSTITUTIONS INTO THE WORK, MAKING SUCH CHANGES AS MAY BE REQUIRED FOR THE WORK TO BE COMPLETE IN ALL RESPECTS.
WHERE THE MANUFACTURER'S RECOMMENDED DETAILS ARE USED, THE MANUFACTURER SHALL BE RESPONSIBLE FOR THE PERFORMANCE OF THEIR PRODUCT. ALL WORK NOT SPECIFICALLY MENTIONED THAT IS REQUIRED TO MAKE THE WORK COMPLETE AND OPERATIONAL SHALL BE INCLUDED.

CODES - CONSTRUCTION SHALL COMPLY WITH ALL APPLICABLE NATIONAL, STATE AND LOCAL BUILDING CODES. IT IS THE RESPONSIBILITY OF THE CONTRACTOR AND OWNER TO INSURE COMPLIANCE WITH SAID CODES AND MODIFY THE SPECIFICATIONS AS NEEDED TO COMPLY WITH SUCH CODES.

MEASUREMENTS - THE CONTRACTOR SHALL CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS BEFORE PROCEEDING WITH CONSTRUCTION. DO NOT SCALE DRAWINGS. NOTED DIMENSIONS TAKE PRECEDENCE.

WORKMANSHIP - WORKMANSHIP SHALL CONFORM TO THE BEST AND HIGHEST STANDARDS OF QUALITY IN EACH TRADE AND SHALL INCLUDE ALL ITEMS OF FABRICATION, CONSTRUCTION AND INSTALLATION. ALL WORK SHALL BE COMPLETED BY SKILLED TRADESMEN AND MECHANICS. INSTALLATION OF ALL EQUIPMENT AND MATERIALS SHALL BE IN STRICT ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.

INSURANCE - BUILDERS RISK INSURANCE SHALL BE MAINTAINED BY THE CONTRACTOR DURING THE COURSE OF CONSTRUCTION UNTIL FINAL ACCEPTANCE BY THE OWNER. ALL BONDING AND INSURANCE REQUIREMENTS SHALL BE COORDINATED WITH THE OWNER PRIOR TO BEGINNING CONSTRUCTION. ALL CONTRACTORS SHALL PROVIDE AND BE SOLELY RESPONSIBLE FOR NECESSARY BARRICADES AND SAFETY PRECAUTIONS, AND STRICTLY ADHERE TO ALL GOVERNING CODES ON SAFETY, INCLUDING THE OSHA ACT.

CLEANING AND WASTE MANAGEMENT - CONSTRUCTION SITE TO BE IN A CLEAN AND ORDERLY CONDITION THROUGHOUT THE CONSTRUCTION PROCESS. CLEAN INTERIOR SPACES PRIOR TO THE START OF FINISH PAINTING AND THE APPLICATION OF OTHER FINISHES. AT THE CONCLUSION OF CONSTRUCTION, THE PROJECT SHALL BE CLEANED. THIS SHOULD INCLUDE BUT NOT BE LIMITED TO: CLEANING THE INTERIOR AND EXTERIOR GLASS, SURFACES EXPOSED TO VIEW, REMOVE TEMPORARY LABELS, STAINS AND FOREIGN SUBSTANCES, POLISH TRANSPARENT AND GLOSSY SURFACES, VACUUM CARPETED AND SOFT SURFACE AREAS, SWEEP AND MOP ALL TILESD SURFACES, ETC. REPLACE FILTERS OF OPERATING EQUIPMENT. CLEAN EQUIPMENT AND FIXTURES TO A SANITARY CONDITION. CLEAN EXTERIOR SUCH AS DEBRIS FROM ROOF, GUTTERS, LANDSCAPE AREAS, DRIVEWAYS AND WALKS, ETC. REMOVE ALL WASTE AND STORE SURPLUS MATERIALS.

TEMPORARY FACILITIES - CONTRACTOR SHALL MAKE NECESSARY CONNECTION TO EXISTING UTILITIES FOR TEMPORARY POWER AND WATER SUPPLIES AND SHALL COORDINATE SUCH WITH THE OWNER PRIOR TO CONNECTION. CONTRACTOR SHALL PROVIDE AND MAINTAIN IN A NEAT AND SANITARY CONDITION SUCH ACCOMMODATIONS FOR THE USE OF HIS EMPLOYEES AS WILL COMPLY WITH LAWS AND REGULATIONS. TEMPORARY TOILET FACILITIES MAY CONSIST OF PORTABLE TOILETS. TOILET FACILITIES SHALL BE KEPT SUPPLIED AND CLEAN AND IN SANITARY CONDITION UNTIL THE COMPLETION OF THE WORK AND THEN SHALL BE REMOVED FROM THE SITE. UPON REMOVAL, THE SITE SHALL BE PROPERLY CLEANED AND GRADED. THE CONTRACTOR SHALL PROVIDE TEMPORARY BARRICADES TO SEPARATE CONSTRUCTION AREAS FOR PUBLIC SAFETY AROUND ENTIRE PERIMETER OF CONSTRUCTION AREA.

PROTECTING MATERIALS AND INSTALLED CONSTRUCTION - THE CONTRACTOR SHALL PROVIDE A MATERIAL STORAGE AREA ADJACENT TO THE AREA OF CONSTRUCTION. LOCATION SHALL BE COORDINATED WITH THE OWNER. MATERIALS SHALL BE PROTECTED FROM RAIN AND OTHER SOURCES OF MOISTURE. BUILDING MATERIALS WITH VISIBLE SIGNS OF WATER DAMAGE SHALL NOT BE INSTALLED. CONTRACTOR TO PROTECT ALL INSTALLED CONSTRUCTION. IF PRODUCTS OR MATERIALS COME WITH A PROTECTIVE COATING, CONTRACTOR SHALL MAINTAIN PROTECTIVE COATING UNTIL CONSTRUCTION IS COMPLETE. CONTRACTOR SHALL REPLACE ANY ITEMS THAT BECOME DEFECTIVE OR DAMAGED. ALL DUCTS AND OTHER RELATED MECHANICAL SUPPLY AND RETURN OPENINGS SHALL BE COVERED WITH TAPE, PLASTIC, OR SHEET METAL UNTIL THE FINAL STARTUP OF THE HVAC EQUIPMENT.

EXISTING CONDITIONS - CONTRACTOR SHALL REVIEW CONSTRUCTION DOCUMENTS AND PROVIDE NECESSARY SITE WORK, EXCAVATION AND GRADING AS REQUIRED TO CONSTRUCT SAID PROJECT.

MASONRY - CONTRACTOR SHALL REVIEW CONSTRUCTION DOCUMENTS AND PROVIDE LABOR AND MATERIALS PERTAINING TO MASONRY WORK AS REQUIRED IN SAID DOCUMENTS AND AS SPECIFIED HEREIN, WHILE COMPLYING WITH ALL APPLICABLE BUILDING CODES. DRY BRUSH MASONRY SURFACE AT THE END OF EACH DAY'S WORK AND AFTER FINAL POINTING USING WIRE BRUSHES TO REMOVE MORTAR BUT EXERCISE CARE NOT TO SCRATCH OR DAMAGE WORK. FINAL CLEANING OF MASONRY TO OCCUR MINIMUM 7 DAYS AFTER MASONRY WORK IS COMPLETED. COMPLY WITH RECOMMENDATIONS OF MANUFACTURERS OF CHEMICAL CLEANERS FOR PROTECTING BUILDING SURFACES, LANDSCAPE, PERSONS AND PROPERTY AGAINST DAMAGE FROM EXPOSURE TO THEIR PRODUCTS. MORTAR SHALL BE TYPE "M" OR "S" IN ACCORDANCE WITH ASTM C270, 2500 PSI. GROUT SHALL BE IN ACCORDANCE WITH ASTM C270, TYPE M, 2500 PSI CONCRETE USING PEA GRAVEL FOR COARSE AGGREGATE WITH A MAXIMUM AGGREGATE SIZE OF 3/8" AND AN 8" MINIMUM TO 11" MAXIMUM SLUMP. MORTAR JOINTS THICKNESS AND PROFILE TO MATCH EXISTING. CONTINUOUS FLASHING SHALL BE INSTALLED AT THE BOTTOM OF THE WALL, ABOVE GRADE, WITH WEEPHOLES AT 32" OC. FLASHING SHOULD BE INSTALLED AT THE HEADS AND SILLS OF ALL OPENINGS. PROVIDE WEEP-HOLES, SPACED APPROXIMATELY 32 INCHES ON CENTER IN VERTICAL JOINTS OF FIRST COURSE AND OVER ALL COUNTER FLASHING AND THROUGH WALL FLASHING ON EXTERIOR WALLS. UNITS WITH SIZE, COLOR AND SHAPE TBD.

INTERIOR WALLS - INTERIOR WALLS SHALL BE 2"X4"**WOOD STUDS** OR, WHERE PLUMBING STACKS ARE PRESENT, 2"X6" WOOD STUDS AT 16" OC, WITH SINGLE BOTTOM PLATES AND DOUBLE TOP PLATES THROUGHOUT. REFER TO STRUCTURAL DRAWINGS. PROVIDE SOLID BLOCKING AT MID-HEIGHT OF ALL WALLS WHICH EXCEED 9'-0" IN HEIGHT AND ADDITIONAL BLOCKING AS SHOWN ON THESE DRAWINGS OR REQUIRED BY CODE.

FINISH CARPENTRY - ALL ARCHITECTURAL TRIM AND WOODWORK SHALL BE PRIMED FJ PINE NO. 1 GRADE MATERIAL SUITABLE FOR PAINT FINISHES. WOOD THAT WILL BE STAINED SHALL BE CLEAR OF KNOTS WITH CONCEALED JOINTS. PROVIDE AND INSTALL INTERIOR WOOD TRIM AS SHOWN ON INTERIOR DRAWINGS/SCHEDULE.

WOOD STAIRS - GENERALLY THE VERTICAL DIMENSION OF EACH RISER SHOULD BE NO MORE THAN 7.5" AND THE HORIZONTAL DIMENSION OF EACH TREAD WILL BE 11". A MINIMUM OF 6'-8" CLEAR HEADROOM IS REQUIRED, MEASURED FROM THE FRONT EDGE OF THE TREAD TO A LINE PARALLEL TO THE STAIR RUN. STAIR TREADS SHALL BE CONSTRUCTED OF 3/4" THICK FINISH GRADE LUMBER, RISERS SHALL BE CONSTRUCTED OF 3/4" FINISH GRADE LUMBER STRUCTURAL STAIR STRINGERS SHALL BE CONSTRUCTED OF 2"X12"S, GLUE AND NAIL STAIR ASSEMBLY TOGETHER.

METAL RAILINGS - INSTALL METAL HAND RAILINGS AND GUARDRAILS TO MEET ALL APPLICABLE BUILDING CODES, WITH APPROPRIATE DETAILING AND PATTERNS AS SHOWN IN CONSTRUCTION DOCUMENTS. METAL SHALL BE SHOP BUILT, WELDED TOGETHER, CLEANED THOROUGHLY AND PAINTED WITH TWO COATS OF AN ANTI-RUST PRIMER. AFTER INSTALLATION, APPLY AN ADDITIONAL COAT AND ANTI-RUST PRIMER IN PREPARATION FOR FINISH COATS.

EXTERIOR MOLDINGS - HIGH-DENSITY, DURABLE, NON-WATER ABSORBING, POLYURETHANE POLYMER COMPARABLE TO KILN-DRIED WHITE PINE MILLWORK, WITH HIGHER SKIN DENSITY. PROVIDE UNITS WITH MANUFACTURER'S STANDARD BARRIER COAT AND SHOP-APPLIED PRIMER TO RECEIVE FIELD APPLIED FINISH PAINT COATING. FASTENERS, JOINT COMPOUND AND ADHESIVE SOURCED AND INSTALLED AS RECOMMENDED BY MANUFACTURER.

THERMAL AND MOISTURE PROTECTION - CONTRACTOR SHALL REVIEW CONSTRUCTION DOCUMENTS AND PROVIDE LABOR AND MATERIALS PERTAINING TO THERMAL AND MOISTURE PROTECTION WORK AS REQUIRED IN SAID DOCUMENTS AND AS SPECIFIED HEREIN, WHILE COMPLYING WITH ALL APPLICABLE BUILDING CODES.

DAMP PROOFING AND WATERPROOFING - OVER STUDS AND SHEATHING, INSTALL ONE LAYER OF APPROVED MOISTURE BARRIER OVERLAPPED A MINIMUM OF 6" EXCEPT AT STUCCO FINISH, PROVIDE 2 LAYERS. ALL JOINTS AND PENETRATIONS IN WALLS, FLOORS, AND ROOFS SHALL BE MADE WATERTIGHT USING APPROVED METHODS AND MATERIALS. WATERPROOFING AND DAMPPROOFING RECOMMENDATIONS CONTAINED HEREIN ARE MINIMUM. CHECK WITH LOCAL CODE OFFICIALS FOR ADDITIONAL REQUIREMENTS. THERMAL PROTECTION - EFFECTIVE R VALUES SHALL BE IN ACCORDANCE WITH LOCAL AND STATE ENERGY CODES. ALL PLUMBING CHASES SHALL BE INSULATED WITH BATT INSULATION FOR SOUND ATTENUATION.

THERMAL PROTECTION - EFFECTIVE R VALUES SHALL BE IN ACCORDANCE WITH LOCAL AND STATE ENERGY CODES. ALL PLUMBING CHASES SHALL BE INSULATED WITH BATT INSULATION FOR SOUND ATTENUATION.

EXTERIOR WALLS - MIN WALL INSULATION SHALL BE R VALUE OF 19.

INTERIOR WALLS - INSTALL R-11 BATT-INSULATION AT BATH ROOMS, PLUMBING CHASES, LAUNDRY ROOMS, MECHANICAL CLOSETS AND OTHERWISE SPECIFIED FOR SOUND ATTENUATION.

CEILINGS - ATTIC INSULATION SHALL BE BLOWN CELLULOSE (OR EQUAL) AND HAVE MIN. R-VALUE OF 38. PROVIDE BAFFLES AT EAVES TO PROVIDE FOR VENTILATION. AT FLAT ROOFS PROVIDE MIN 10" DENSELY PACKED, 3.5 LBS/CUFT DENSITY, BLOWN CELLULOSE BETWEEN ROOF/CEILING JOISTS HELD IN PLACE WITH BREATHABLE MESH SUSPENDED FROM STRUCTURE (INSULWEB OR EQUAL) AS NEEDED. USE OF MIN R-VALUE OF COMBINATION IS R38.

UNDERLAYMENT - ON ALL ROOF SURFACES INSTALL A PEEL AND STICK UNDERLAYMENT CONSISTS OF A HIGH-DENSITY POLYESTER OR POLYETHYLENE LAYER. THIS IS SATURATED IN MODIFIED BITUMEN. FOR ROOFS THAT ARE STEEPER THAN A 6:12 PITCH USE A SINGLE LAYER OF UNDERLAYMENT. FOR ROOFS WITH LESS THAN A 6:12 PITCH INSTALL A DOUBLE LAYER OF UNDERLAYMENT AND OVERLAP A MINIMUM OF 18". OVERLAP UNDERLAYMENT A MINIMUM OF 4" VERTICALLY AND 12" HORIZONTALLY. CONTINUE FELT 6" UP ALL VERTICAL SURFACES AND 4" OVER GUTTER AND VALLEY METAL. LAY COURSES PARALLEL WITH EAVES. DO NOT STRETCH COURSES.

CEMENT TILE ROOF SYSTEM - INSTALL ROOF TILE SYSTEM WITH ONE OF THE FOLLOWING PROFILES; FLAT/LOW PROFILE, MEDIUM PROFILE, OR HIGH/BARREL PROFILE OVER SPECIFIED ROOF FRAMING AND SHEATHING. INSTALL #30 ROOF UNDERLAYMENT OVER SHEATHING WITH BATTEN SYSTEM SPACED AND FASTENED AS SPECIFIED BY MANUFACTURE.

LOW SLOPE METAL ROOF - INSTALL 50 YEAR WARRANTY LOW-SLOPE METAL ROOF SYSTEM WITH CONCEALED FASTENERS. INSTALL A LAYER OF FIRE-RETARDANT UNDERLAYMENT BETWEEN ROOF STRUCTURE AND METAL. COLOR TBD

MANUFACTURED GUTTERS AND DOWNSPOUTS - INSTALL 25 GAUGE ALUMINUM 6" WIDE COVERED GUTTERS AND 5" DOWNSPOUTS. ATTACH EVERY 2'-6" ON CENTER (OC) WITH STRAPS AND/OR FASTENERS. COORDINATE LOCATION OF DOWNSPOUTS TO CARRY WATER AWAY FROM THE FOUNDATION.

STUCCO - INSTALL SELF FURRING METAL LATH OVER 2 LAYERS WEATHER RESISTIVE BARRIER. APPLY WEEP SCREED AT BASE. STUCCO SHOULD BE HELD MIN 6" FROM ADJACENT HORIZONTAL SURFACE. MINIMIZE LATH LAPPING; SECURE LATH UNIFORMLY WITH OPEN ENDS SECURED TIGHTLY. CONTROL JOINTS SHALL BE AS SPECIFIED BY MANUFACTURER, BUT MINIMALLY, AT WINDOWS AND DOORS, AT LENGTHS OVER 16', AND AREAS GREATER THAN 150 SOFT. INSTALL LAHABRA FASTWALL 100 STUCCO SYSTEM (OR EQUAL) INCLUDING BASE COAT, ACRYLIC PRIMER, AND ACRYLIC FINISH COAT AS SPECIFIED BY MANUFACTURER. COMPLETE INSTALLATION WITH SEALANTS AT PENETRATIONS, WEEP SCREEDS, JOINT AND CORNER BEADS AND OTHER INSTALLATION ACCESSORIES AS RECOMMENDED BY THE MANUFACTURER.

FLASHING AND SHEET METAL - INSTALL APPROPRIATE FLASHING AT ALL CHIMNEYS, JOINTS OF WALLS, VENT PIPES AND OTHER CONNECTION POINTS TO PREVENT THE INFILTRATION OF WATER. FLASHING SHALL BE ASSEMBLED OF 26 GAUGE MINIMUM GALVANIZED, CORROSION RESISTANT SHEET METAL. VALLEYS SHALL BE WRAPPED WITH 20" WIDE GALVANIZED FLASHING AND EXTEND 10" IN EACH DIRECTION FROM CENTER-LINE OF VALLEY. USE 4"WIDE X 4"HIGH X 10LONG GALVANIZED FLASHING BETWEEN WALL SIDING AND ROOF KEEP FLASHING CONCEALED EXCEPT WHERE EXPOSED ON VERTICAL SURFACES OR COUNTER FLASHING.

JOINT SEALANTS - USE A 50 YEAR WARRANTY SILICON BASED CAULK AT HIGH EXPANSION/COMPRESSION AREAS, SUCH AS AROUND CHIMNEYS, TILE, CERAMIC, AND AROUND ENAMEL AND PRE-FABRICATED TUBS AND SHOWERS. CAULK AND SEAL AROUND ALL WINDOW AND DOOR FRAMES AND BETWEEN WALL SOLE PLATES AND FLOORS AND AT EXTERIOR SIDING JOINTS. FOR EXTERIOR WINDOWS, DOOR FRAMES, INTERIOR TRIM, WOODWORK AND OTHER PAINTABLE SURFACES USE A CLEAR LATEX BASED CAULK. COLOR SHALL MATCH PAINT.

OPENINGS - MANUFACTURED DOORS AND WINDOWS SHALL BE CERTIFIED AND LABELED IN COMPLIANCE WITH THE APPROPRIATE INFILTRATION STANDARDS LISTED IN THE RESIDENTIAL ENERGY CODE. SITE-CONSTRUCTED DOORS AND WINDOWS, EXTERIOR JOINTS, AND OPENINGS IN THE BUILDING ENVELOPE SHALL BE CAULKED, GASKETED, WEATHERSTRIPPED OR OTHERWISE SEALED, EXCEPT FIRE RATED DOORS ON WINDOWS, AND UNFRAMED GLASS DOORS. SEE AD 4 FOR ADDITIONAL REQUIREMENTS AND SCHEDULES. CONTRACTOR SHALL PROVIDE ACCESS PANELS AS REQUIRED BY PLUMBING, MECHANICAL AND OTHER TRADES, AND AS REQUIRED BY CODES, LOCATION(S) AND TYPE(S) TO BE APPROVED BY THE OWNER.

GYPSUM BOARD - GYPSUM BOARD MUST BE HELD FIRMLY AGAINST THE FRAMING WHILE FASTENING TO AVOID LATER MOVEMENT OF GYPSUM BOARD ON THE SHANK OF THE NAILS OR SCREWS. SHEATH WALLS WITH 1/2" GYPSUM WALLBOARD, AND CEILINGS WITH 5/8" GYPSUM WALL BOARD, EITHER VERTICALLY WITH LONG EDGES PARALLEL TO FRAMING, OR HORIZONTALLY WITH LONG EDGES AT RIGHT ANGLES TO FRAMING MEMBERS. SQUARE CORNERS. APPLY ONE LAYER TO ALL WALL SURFACES. OFFSET JOINTS BETWEEN LAYERS AT LEAST 10". WALL AND CEILING FINISH LEVEL 5, SMOOTH TEXTURE. IN GARAGES, AROUND GAS WATER HEATERS AND AS REQUIRED BY APPLICABLE BUILDING CODES, INSTALL 5/8" TYPE "X" FIRE-RATED GYPSUM WALLBOARD; FINISH LEVEL 2. AROUND SHOWERS, TUBS, WHIRLPOOLS, OR AS REQUIRED BY APPLICABLE BUILDING CODES, INSTALL 1/2" WATER RESISTANT FIBER CEMENT BOARD, FINISH LEVEL 2

FLOORING - CONTRACTOR SHALL PROPERLY CLEAN ALL SURFACES TO BE COVERED AND INSTALL APPROPRIATE UNDERLAYMENT PER MANUFACTURERS RECOMMENDATIONS.

TILING - TILES SHALL BE APPROPRIATE GRADE AND FINISH IN ACCORDANCE WITH APPLICABLE BUILDING CODES AND OWNER REQUIREMENTS. INSTALLATION SHOULD BE CARRIED OUT OVER APPROPRIATE UNDERLAYMENT WITH A SLOW SETTING CEMENT ADHESIVE, WELL MIXED PER MANUFACTURER RECOMMENDATIONS. GROUTING OF CONTROL JOINTS CAN BE EXECUTED EITHER WITH CEMENT BASED GROUT OR WITH RESIN BASED ORGANIC MATERIALS.

WOOD FLOORING - INSTALL A SINGLE LAYER OF 15 LB FELT VAPOR BARRIER BETWEEN SUB-FLOOR DECKING AND HARDWOOD FLOORS. WHEN INSTALLING HARDWOODS OVER CONCRETE SLABS INSTALL A LAYER OF 1/2"PLYWOOD AS UNDERLAYMENT OVER 6 MIL POLYETHYLENE. ALONG WALLS AND PERMANENT OBJECTS, INSTALL A 1"1" QUARTER ROUND MOLDING TO CONCEAL EXPANSION AREA. WOOD FLOORING SHALL BE TONGUE AND GROOVE CONSTRUCTION AND TRUE SQUARE EDGED FOR A FLAT SMOOTH SURFACE. WOOD FLOORING CAN BE FASTENED WITH APPROPRIATE NAILS, STAPLES OR GLUE. CHECK SPECIFIC MANUFACTURER'S RECOMMENDATIONS.

EXTERIOR PAINTING - ALL NAIL HEADS SHALL BE SET BELOW THE SURFACE AND FINISHED SMOOTH. IF MILDEW IS EVIDENT, THE MILDEW MUST BE REMOVED AND SURFACE TREATED TO INHIBIT FURTHER MILDEW GROWTH. EXTERIOR WALLS SHALL RECEIVE A PRIMER COAT AND TWO COATS OF FLAT OR SEMI-GLOSS PAINT. PRE-PRIME THE EDGES AND ENDS OF LUMBER AND SIDING PRIOR TO CONSTRUCTION. WHEN STAINING, PRE-PRIME WITH THE SAME PROD

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EROSION AND SEDIMENT CONTROL DURING AND AFTER CONTRUCTION

PROCEDURES

EVALUATE
Make a Site Inventory and evaluate the resources on the lot before demolition. Identify trees that you want to save and vegetation that will remain. Also identify areas where you want to limit construction traffic. Wherever possible, preserve existing vegetation to help control erosion and off-site sedimentation.

SELECT AND INSTALL
Determine the specific erosion/sedimentation control practices needed and install them before clearing the site. Among the more commonly used practices are vegetative filter strips, silt fences, gravel drives, and inlet protection.

MAINTAIN
Develop a Maintenance Program Maintenance of all practices is essential for them to function properly. Practices should be inspected twice a week and after each rainfall event. When a problem is identified, repair or replace the practice immediately. If frequent repairs are required (such as Silt Fence being knocked down), another more substantial practice may need to be selected. In addition, any sediment that is tracked onto the street should be scraped and deposited in a protected area. Do not flush sediment from the street with water.

REVEGETATE
Providing a vegetative cover is the most important practice in preventing erosion and sediment. Therefore, establish vegetation as soon as possible following demolition.

CONSTRUCTION SEQUENCE FOR EROSION AND SEDIMENTATION CONTROL PRACTICES

1. Evaluate the site before demolition; mark vegetative areas and trees to be protected, unique areas to preserveand vegetation suitable for filter strips, especially in perimeter areas.
   - Refer to Tree Plan for the location and requirements for Tree Protection.
   - Do not grade, burn, stock pile topsoil, or park vehicles near trees or in areas marked for preservation.

2. Identify the areas where sediment-laden runoff could leave the construction site and install perimeter controls to minimize the potential for off-site sedimentation. Perimeter controls to be placed before any earthmoving activities begin.
   - On slopes of less than six percent, preserve a 20-to 30-foot wide (minimum) vegetative buffer strip around the perimeter of the property, and use it as a filter strip for trapping sediment. • Do not mow filter strip vegetation shorter than four inches.
   - Use silt fencing along the perimeter of the lot's downslope side(s) to trap sediment.
   - Restrict all lot access to the existing driveway or install new stabilized construction entrance to prevent vehicles from tracking mud onto roadways or destroying perimeter controls.

3. Prepare the site for demolition and construction. Make sure all contractors are aware of areas to be protected.

REFERENCE SITE PLANS FOR TREE SCHEDULES, TREE NOTES, TREE PROTECTION LOCATIONS, AND PROPOSED REMOVAL MITIGATION

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4. Demolish areas of the existing home and disconnect utility connections.

5. Maintain Control Practices until construction is completed and the lot is stabilized.
   - Inspect the control practices daily during the demolition phase. Repair as needed to maintain control.
   - Toward the end of each workday, sweep or scrape up any soil tracked onto roadway(s). Do not flush mud down the street with water.
   - Between the demolition and construction phases, inspect control practices after storm events, and no less than monthly. Repair as needed to maintain control.

6. Revegetate Building Site Immediately after construction activities are completed, stabilize the lot with sod, seed, and/ or mulch.
   - Once the sod and/or vegetation is well established, remove any remaining temporary erosion and sediment control practices.

INDIVIDUAL EROSION AND SEDIMENT CONTROL PRACTICES

1. The contractor is responsible for maintaining and inspecting all erosion and sediment control practices, including silt fences and construction entrances during demolition and construction. Including the removal and proper disposal of accumulated silt and debris.
2. The contractor shall not begin work until tree protection and erosion and sedimentation control practices have been installed.
3. The contractor shall be responsible for keeping the streets free of mud, dirt, debris, and material at all times and shall clean the streets on an regular basis and at the direction of the City.
4. Increased stormwater peal flows during construction must be mitigated with temporary best management practices to prevent harm to neighboring properties.

SILT FENCE
1. Install silt fence parallel to the contour of the land.
2. Extend ends upslope to allow water to pond behind fence.
3. Excavate a trench 4-inches wide, 8-inches deep.
4. Install fence with posts on the down slope side.
5. Place 12-inches of fabric in the trench, extending the bottom four inches toward the upslope side.
6. Join silt fence sections by using a wrap joint.
7. Backfill trench with soil materials and compact.
8. Inspect at least weekly and after each storm event, repairing as needed and removing sediment deposits when they reach one-half the fence height.

STABALIZED CONSTRUCTION ENTRANCE
1. Place six inches of 2" to 4"coarse aggregate over a stable subgrade.
2. Construct the drive at least 12-feet wide and 50-feet long or the distance to the foundation.
3. Add stone as needed to maintain six inches of clean depth.
4. To improve stability or if wet conditions are anticipated, place geotextile fabric on the graded foundation.

REFERENCE CIVIL DRAWINGS FOR ADDITIONAL ESCP, INCLUDING CONTROLS LOCATIONS

STORM WATER POLLUTION CONTROL REQUIREMENTS FOR CONSTRUCTION ACTIVITIES
MINIMUM WATER QUALITY PROTECTION REQUIREMENTS FOR ALL CONSTRUCTION PROJECTS/ CERTIFICATION STATEMENT

CONSTRUCTION MEANS CONSTRUCTING, CLEARING, GRADING OR EXCAVATION THAT RESULTS IN SOIL DISTURBANCE AND INCLUDES STRUCTURE TEARDOWN.

A COPY OF THIS PLAN SHALL BE KEPT ON THE PROJECT SITE AT ALL TIMES .

ERODED SEDIMENTS AND POLLUTANTS MUST BE RETAINED ON SITE AND MAY NOT BE TRANSPORTED FROM THE SITE VIA SHEETFLOW, SWALES, AREA DRAINS, NATURAL DRAINAGE COURSE OR WIND. MAINTAIN EROSION CONTROL MEASURES THROUGHOUT CONSTRUCTION AND RELOCATE EROSION CONTROL MEASURES OR INSTALL NEW MEASURES SO THAT AS SITE CONDITIONS CHANGE, THE CONTROLS ARE ALWAYS IN ACCORDANCE WITH TRAVIS COUNTRY REQUIREMENTS.

STOCKPILES OF EARTH AND OTHER CONSTRUCTION-RELATED MATERIALS MUST MUST BE PROTECTED FROM BEING TRANSPORTED FROM THE SITE BY WIND OR WATER.

FUELS, OILS, SOLVENTS AND OTHER TOXIC MATERIALS MUST BE STORED IN ACCORDANCE WITH THEIR LISTING AND ARE NOT TO CONTAMINATE THE SOIL NOR THE SURFACE WATERS. ALL APPROVED TOXIC STORAGE CONTAINERS ARE TO BE PROTECTED FROM THE WEATHER. SPILLS MUST BE CLEANED UP IMMEDIATELY AND DISPOSED OF IN A PROPER MANNER. SPILLS MAY NOT BE WASHED INTO THE DRAINAGE SYSTEM.

NON-STORM WATER RUN OFF FROM EQUIPMENT AND VEHICLE WASHING AND ANY OTHER ACTIVITY SHALL BE CONTAINED AT THE PROJECT SITE.

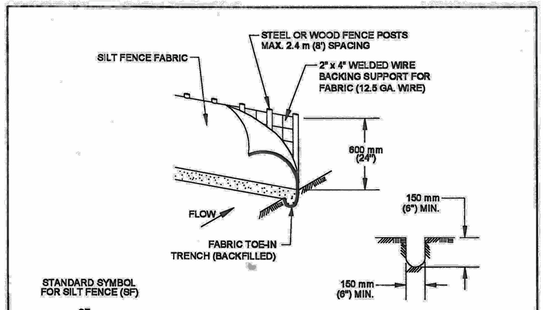
EXCESS OR WASTE CONCRETE MAY NOT BE WASHED INTO THE PUBLIC WAY OR ANY DRAINAGE SYSTEM. PROVISIONS SHALL BE MADE TO RETAIN CONCRETE WASTES ON-SITE UNTIL THEY CAN BE APPROPRIATELY DISPOSED OF OR RECYCLED.

TRASH AND CONSTRUCTION-RELATED SOLID WASTES MUST BE DEPOSITED INTO A COVERED RECEPTACLE TO PREVENT CONTAMINATION OF RAIN WATER AND DISPERSAL BY WIND.

SEDIMENTS AND OTHER MATERIALS MAY NOT BE TRACKED FROM THE SITE BY VEHICLE TRAFFIC. THE CONSTRUCTION ENTRANCE ROADWAYS MUST BE STABILIZED SO AS TO INHIBIT SEDIMENTS FROM BEING DEPOSITED INTO THE PUBLIC WAYS. ACCIDENTAL DEPOSITIONS MUST BE SWEPT UP IMMEDIATELY AND MAY NOT BE WASHED DOWN BY RAIN OR BY ANY OTHER MEANS.

PROTECT TREES IN THE RIGHT-OF-WAY AND THOSE SAVED ON SITE FROM CONSTRUCTION DISTURBANCES

UPON COMPLETION OF THE PROJECT, ALL DISTURBED AREAS MUST BE STABILIZED BY
a)RE-VEGETATION OF LAWNS AND ALL DISTURBED AREAS USING SOD, SEE, OR SOIL BLANKET (PERMANENT EROSION CONTROLS) - WITH ADEQUATE WATERING TO ENSURE ESTABLISHMENT;
b) PERMANENT LANDSCAPING, RETAINING WALLS, DRIVEWAYS;
c) DISSIPATERS FOR ROOF DOWNSPOUTS, CONCENTRATED DRAINAGE FLOWS, AND OUTFALL POINTS.



1. STEEL OR WOOD POSTS WHICH SUPPORT THE SILT FENCE SHALL BE INSTALLED ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE. POST MUST BE EMBEDDED A MINIMUM OF 300 mm (12 INCHES). IF WOOD POSTS CANNOT ACHIEVE 300 mm (12 inches) DEPTH, USE STEEL POSTS.

2. THE TOE OF THE SILT FENCE SHALL BE TRENCHED IN WITH A SPADE OR MECHANICAL TRENCHER, SO THAT THE DOWNSLOPE FACE OF THE TRENCH IS FLAT AND PERPENDICULAR TO THE LINE OF FLOW.

3. THE TRENCH MUST BE A MINIMUM OF 150 mm (6 inches) DEEP AND 150 mm (6 inches) WIDE TO ALLOW FOR THE SILT FENCE FABRIC TO BE LAID IN THE GROUND AND BACKFILLED WITH COMPACTED MATERIAL.

4. SILT FENCE FABRIC SHOULD BE SECURELY FASTENED TO EACH STEEL OR WOOD SUPPORT POST OR TO WOVEN WIRE , WHICH IS IN TURN ATTACHED TO THE STEEL OR WOOD FENCE POST.

5. INSPECTION SHALL BE MADE WEEKLY OR AFTER EACH RAINFALL EVENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTY AS NEEDED.

6. SILT FENCE SHALL BE REMOVED WHEN THE SITE IS COMPLETELY STABILIZED SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.

7. ACCUMULATED SILT SHALL BE REMOVED WHEN IT REACHES A DEPTH OF 150 mm (6 inches). THE SILT SHALL BE DISPOSED OF ON AN APPROVED SITE AND IN SUCH A MANNER THAT WILL NOT CONTRIBUTE TO ADDITIONAL SILTATION.

CITY OF AUSTIN WATERSHED PROTECTION DEPARTMENT	SILT FENCE	
ADOPTED 9/1/2011	THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.	STANDARD NO. 642S-1

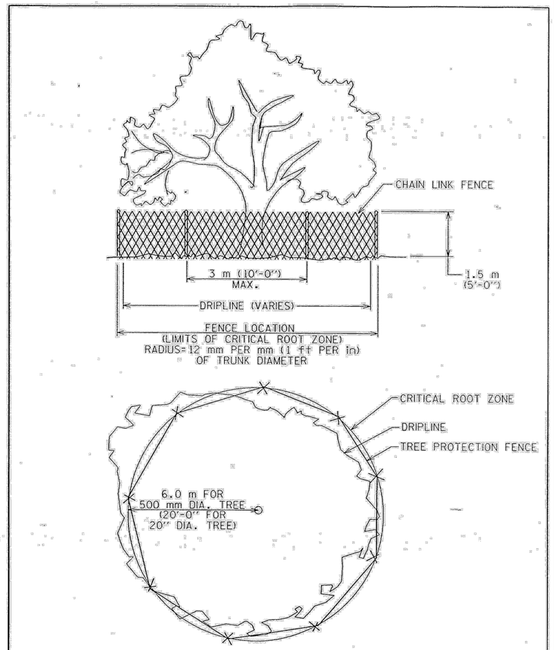
WEST LAKE HILLS TREE AND VEGETATION REMOVAL POLICIES

The following list of Tree and Vegetation Removal Policies is derived from the West Lake Hills Code of Ordinances and **does not** represent the complete list of all regulations and laws regarding vegetation removal. Property Owners and Contractors are encouraged to visit the City's website at www.westlakehills.org and click on the CODE OF ORDINANCES link in order to review all relevant sections of the Code.

This list includes only the most common and/or relevant policies and procedures governing tree and vegetation removal.

1. **The City Arborist must be notified 24 to 48 hours prior to any work being performed regardless of when the permit was issued.**
2. To prevent the spread of Oak Wilt disease, the trimming of Oak trees is prohibited from February 1st to June 30th. All wounds and cuts to Oak trees must be sealed immediately after cutting, trimming, wounding or pruning. Consult with City staff for more information about Oak Wilt prevention.
3. This permit applies only to the site location listed above and must be posted in a location that can be seen from the nearest street (preferably the mailbox) during the work.
4. By applying for a Tree/Vegetation Removal Permit, the owner is consenting to an on-site inspection by City Staff to monitor the work and to confirm compliance with City Code.
5. All brush generated from the pruning of trees shall be properly disposed of at the owner's expense immediately after the tree is pruned.
6. The City of West Lake Hills considers **ALL TREE SPECIES AND VEGETATION** (including "invasive" and "non-native" species) to be important parts of the City's ecosystem and are therefore subject to all regulations in the City's Code of Ordinances.
7. All trees shall be pruned in a professional manner in accordance with current arboricultural standards.
8. Do not make topping cuts or leave rips or stubs in the trees. Remove all broken or hanging limbs. Leave the tree in a balanced, safe and aesthetically pleasing condition.
9. If a tree dies due to improper pruning, the property owner is responsible for replacing the tree.
10. Required replacement vegetation must be installed within 90 days of City approval of the replacement plan and must survive for a minimum of 3 years.
11. THE PROPERTY OWNER IS RESPONSIBLE FOR VERIFYING ALL PROPERTY LINES SO THAT AUTHORIZED REMOVAL OCCURS ON THE SPECIFIED PROPERTY ONLY AND NOT ON ADJACENT PROPERTIES.
12. **In addition to the policies listed above, the Contractor and Property Owner are responsible for conforming with the City's Code of Ordinances at all times.** In the event of a conflict between the policies listed above and the City's Code of Ordinances, the Code shall prevail.

FOR QUESTIONS ABOUT THE PERMIT APPLICATION OR CITY TREE REGULATIONS, CONTACT WEST LAKE HILLS CITY
DEPUTY INSPECTOR ALEX SANCHEZ, (512) 610-6836, asanchez@westlakehills.gov



CITY OF AUSTIN WATERSHED PROTECTION DEPARTMENT	TREE PROPTECTION FENCE TYPE A - CHAIN LINK	
ADOPTED 11/15/2010	THE ARCHITECT/ENGINEER ASSUMES RESPONSIBILITY FOR APPROPRIATE USE OF THIS STANDARD.	STANDARD NO. 610S-2

Revisions By

ARTERBERRY COOKE architecture

Architect:
Alice Arterberry
3411 Windsor Rd
Austin, TX 78703
alice@arterberrycooke.com
323.236.5182

06/19/2025
REGISTERED ARCHITECT
ALICE ARTERBERRY
26018
STATE OF TEXAS

Project Owner:
Michelle and David Ewart
3806 Meandering Creek Cv
Austin TX 78746

Project Address:
419 Ridgewood Rd
West Lake Hills 78746

Contractor:
Captex Construction

ESCP, TREE PROTECTION

drawn by: MJS
checked by: NS
scale: 1/4" = 1'-0"
first issue: 06/19/2025
plot date: 06/19/2025

PERMIT SET

A0.01

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GENERAL NOTES

1. All materials and construction methods for site grading, paving, sitework, and drainage shall be in accordance with the City of Austin Standard Specifications, unless otherwise noted. All work shall be in accordance with the building codes, ordinances, safety codes, and rules and procedures of the City of West Lake Hills.

2. All responsibility for the adequacy of these plans remains with the Engineer who prepared them. In reviewing these plans, the City of West Lake Hills must rely on the adequacy of the work of the design engineer.

3. Prior to any construction, the Contractor shall apply for and secure all proper permits from the appropriate authorities.

4. Blasting or burning shall not be permitted on this project.

5. The contractor shall verify all depths and locations of existing utilities prior to beginning construction. Any discrepancies with the construction plans found in the field shall be brought to the attention of the design engineer immediately. The design engineer shall be responsible for revising the plans as appropriate and submitting a revision to the City.

6. Contractor will be responsible for keeping roads and drives adjacent to and near the site free from soil, sediment, and debris. Contractor will not remove soil, sediment, or debris from any area or vehicle by means of water, only shoveling and sweeping will be allowed. Contractor will be responsible for dust control from the site.

7. Any existing utilities, pavement, curbs, sidewalks, structures, trees, etc., not planned for destruction or removal or other public infrastructure damaged or removed will be by the contractor at his expense before acceptance of the subdivision.

8. After the construction permit has been issued and prior to the beginning construction, the owner or his representative shall schedule a pre-construction conference between the City of West Lake Hills, Design Engineer, Contractor(s), other utility companies, and any other affected parties. The City of West Lake Hills shall be contacted to set up the meeting at least 48 hours prior to the proposed meeting time.

9. Any changes or revisions to these approved plans must be submitted by the design engineer and approved by the City of West Lake Hills prior to construction of the revision.

10. Excess soil shall be removed at the contractor's expense.

11. Available benchmarks that may be utilized for the construction of this project are described as follows:
    a. REFERENCED TO BENCHMARK MONUMENT NAME H-22-4001, TRAVIS COUNTY. TEXAS. Y _ COORDINATE 10,069,361.76, X_COORDINATE 3,105,510.13: NAVD 88

TRENCH SAFETY NOTES

1. In accordance with the Laws of the State of Texas and the U. S. Occupational Safety and Health Administration regulations, all trenches over 5 feet in depth in either hard and compact or soft and unstable soil shall be sloped, shored, sheeted, braced or otherwise supported. Furthermore, all trenches less than 5 feet in depth shall also be effectively protected when hazardous ground movement may be expected. Trench safety systems to be utilized for this project will be provided by the contractor to the City. Trench safety system plans are on sheet ____of the plan set. OR Trench safety system plans as designed and sealed by a professional engineer will be provided by the contractor.

2. In accordance with the U. S. Occupational Safety and Health Administration regulations, when persons are in trenches 4-feet deep or more, adequate means of exit, such as a ladder or steps, must be provided and located so as to require no more than 25 feet of lateral travel.

3. If trench safety system details were not provided in the plans because trenches were anticipated to be less than 5 feet in depth and during construction it is found that trenches are in fact 5 feet or more in depth or trenches less than 5 feet in depth are in an area where hazardous ground movement is expected, all construction shall cease, the trenched area shall be barricaded and the Engineer notified immediately. Construction shall not resume until appropriate trench safety system details, as designed by a professional engineer, are retained and copies submitted to the City of West Lake Hills.

STREET AND DRAINAGE NOTES

1. All testing shall be done by an independent laboratory at the Applicant's expense. A City Inspector shall be present during all tests. Testing shall be coordinated with the City inspector and he shall be given a minimum of 24 hours notice prior to any testing.

2. Backfill behind the curb shall be compacted to obtain a minimum of 85% maximum density to within 3 inches of top of curb. Material used shall be primarily granular with no rocks larger than 3 inches in the greatest dimension. The remaining 3 inches shall be clean topsoil free from all clods and suitable for sustaining plant life.

3. All RCP shall be minimum Class III.

4. The subgrade material for the streets shown herein was tested by _____. The paving sections were designed by _____ in accordance with the current City of Bastrop design criteria. The paving sections are to be constructed as follows:

Street	Station	Flex. Base Thickness	HMAC Thickness	Lime Stab. Thickness

5. A note is required to present flood hazard information. The flood hazard information may be drafted in a statement or list format. Each of the following items must be identified within the list or statement:
    a. Flood Zone and its description, ZONE "X" (AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN
    b. FIRM panel number, and 48453C0445K
    c. FIRM panel effective date. JANUARY 21, 2020

6. FLOOD WARNING: The degree of flood protection required by the City of West Lake hills Flood Damage Prevention Ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. On rare occasions, greater floods can and will occur and flood heights may be increased by man-made or natural causes. Acceptance of this plan by the City Council does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damages. Nor shall acceptance of this plan create liability on the part of the City of West Lake Hills or any official or employee thereof for any flood damages that result from reliance on the information contained within this plan or any administration decision lawfully made hereunder.

TRAFFIC MARKING NOTES

1. Barricades built to the Texas Manual on Uniform Traffic Control Devices standards shall be constructed on all dead-end streets and as necessary during construction to maintain job and public safety.

2. Any methods, street markings, and signage necessary for warning motorists, warning pedestrians, or diverting traffic during construction shall conform to the Texas Manual of Uniform Traffic Control Devices for Streets and Highways, latest edition.

3. All pavement markings, markers, paint, traffic buttons, traffic controls, and signs shall be installed in accordance with the Texas Department of Transportation Standard Specifications for Construction of Highways, Streets and Bridges and the Texas Manual of Uniform Traffic Control Devices for Streets and Highways, latest editions.

EROSION CONTROL NOTES

1. The contractor shall install erosion/sedimentation controls and tree/natural area protective fencing prior to any site preparation work (clearing, grubbing or excavation). The placement of erosion/sedimentation controls shall be in accordance with the current City West Lake Hills Drainage and Erosion Control Manual and the approved Erosion and Sedimentation Control Plan. No erosion controls shall be placed beyond the property lines of the site unless written permission has been obtained from adjacent property owners.

2. All slopes shall be sodded or seeded with approved grass, grass mixtures, or ground cover suitable to the area and season in which they are applied.

3. Any major variation in materials or locations of controls or fences from those shown on the approved plans will require a revision and must be approved by the Engineer. Major revisions must be approved by the City. Minor changes to be made as field revisions to the Erosion and Sedimentation Control Plan may be required by the City Inspector during the course of construction to correct control inadequacies.

4. The contractor is required to inspect the controls at weekly intervals and after any rainfall event to ensure that they are functioning properly. The person(s) responsible for maintenance of controls and fences shall immediately make any necessary repairs to damaged areas. Silt accumulation at controls must be removed when the depth reaches six (6) inches.

5. All temporary erosion control measures shall not be removed until final inspection and approval of the project by the City Inspector. It shall be the responsibility of the Contractor to maintain all temporary erosion control structures and to remove each structure as approved by the City Inspector.

6. Prior to final acceptance by the City, haul roads and waterway crossings constructed for temporary contractor access must be removed, accumulated sediment removed from the waterway and the area restored to the original grade and revegetated. All land clearing debris shall be disposed of in approved spoil disposal sites.

CERTIFICATIONS

OWNER CERTIFICATION

AS OWNER OF THIS PROPERTY, I INTEND TO DEVELOP AND MAINTAIN THIS PROPERTY AS DESCRIBED BY THIS PLAN.

_____ _____
NAME OF OWNER/TRUSTEE DATE

ENGINEER CERTIFICATION
STATE OF TEXAS
COUNTY OF TRAVIS

I, (LICENSED PROFESSIONAL ENGINEER), DO HEREBY CERTIFY THAT THE PUBLIC WORKS AND DRAINA GE IMPROVEMENTS DESCRIBED HEREIN HAVE BEEN DESIGNED IN COMPLIANCE WITH THE CITY OF W EST LAKE HILLS CODE OF ORDINANCES, THE CITY MASTER PLAN AND CITY POLICY.

(SEAL & SIGNATURE OF PROFESSIONAL ENGINEER)

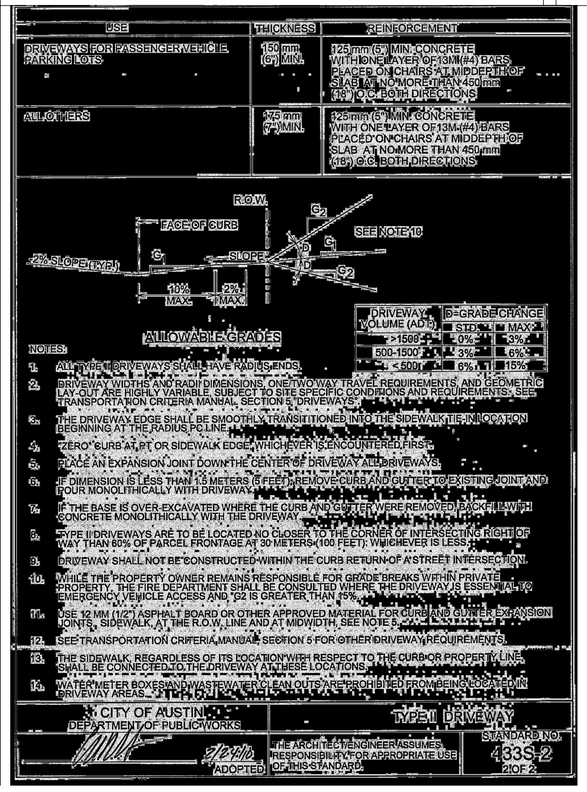
_____ _____
Printed Name of Professional Engineer Date

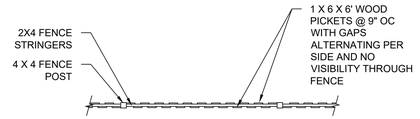
CITY ACCEPTANCE BLOCK

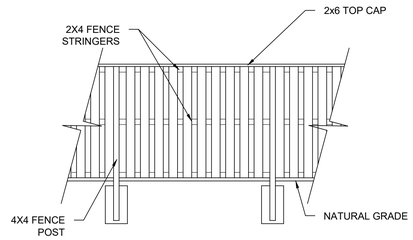
ALL RESPONSIBILITY FOR THE ADEQUACY OF THESE PLANS REMAINS WITH THE ENGINEER WHO PREPARED THEM. IN ACCEPTING THESE PLANS, THE CITY OF WEST LAKE HILLS MUST RELY UPON THE ADEQUACY OF THE WORK OF THE DESIGN ENGINEER.

ACCEPTED FOR CONSTRUCTION:

_____ _____
City Administrator Date







Revisions By

ARTERBERRY COOKE architecture

Architect:
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Austin, TX 78703
alice@arterberrycooke.com
323.206.5182

06/19/2025
REGISTERED ARCHITECT
ALICE ARTERBERRY
26018
STATE OF TEXAS

Project Owner:
Michelle and David Ewart
3806 Meandering Creek Cv
Austin TX 78746

Project Address:
419 Ridgewood Rd
West Lake Hills 78746

Contractor:
Captex Construction

WEST LAKE HILLS GENERAL NOTES

drawn by: MJS
checked by: NS
scale: 1/4" = 1'-0"
first issue: 06/19/2025
plot date: 06/19/2025

PERMIT SET

A0.02

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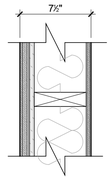
WALL TYPES

Scale 1 1/2" = 1'-0" (TABLOID Scale: 3/4" = 1'-0")

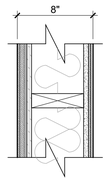
EXTERIOR WALL TYPES



1

STUCCO AND GWB

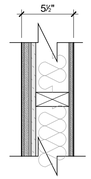
2 X 6 WOOD WALL STUDS WITH R-19 INSULATION 1/2" GWB (TYPE X AT STORAGE AREAS) ON INTERIOR SIDE, TEXTURED FINISH PER SPEC, AND EXTERIOR GRADE SHEATHING PER STRUCTURAL WITH (2) LAYERS CONTINUOUS WRB, AND 3 COAT ACRYLIC STUCCO ON SELF-FURRING LATH.



2

STUCCO AND TILE

2 X 6 WOOD WALL STUDS WITH R-19 INSULATION CEMENTITIOUS BACKERBOARD MORTAR AND TILE ON INTERIOR SIDE, TEXTURED FINISH PER SPEC, AND EXTERIOR GRADE SHEATHING PER STRUCTURAL WITH (2) LAYERS CONTINUOUS WRB, AND 3 COAT ACRYLIC STUCCO ON SELF-FURRING LATH.

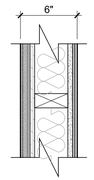


3 3E

STUCCO AND GWB

3:
NEW 2x4 WOOD WALL STUDS, WITH NEW R-19 INSULATION 1/2" GWB (TYPE X AT STORAGE AREAS) ON INTERIOR SIDE, TEXTURED FINISH PER SPEC, AND NEW EXTERIOR GRADE SHEATHING PER STRUC. WITH (2) LAYERS CONTINUOUS WRB, AND 3 COAT ACRYLIC STUCCO ON SELF-FURRING LATH.

3E:
EXISTING WOOD WALL STUDS WITH NEW R-19 INSULATION 1/2" GWB (TYPE X AT STORAGE AREAS) ON INTERIOR SIDE, TEXTURED FINISH PER SPEC, AND EXISTING EXTERIOR GRADE SHEATHING WITH NEW (2) LAYERS CONTINUOUS WRB, AND 3 COAT ACRYLIC STUCCO ON SELF-FURRING LATH.

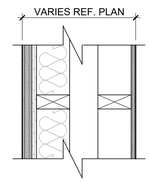


4 4E

STUCCO AND TILE

4:
NEW 2x4 WOOD WALL STUDS, WITH NEW R-19 INSULATION W/ CEMENTITIOUS BACKERBOARD MORTAR AND TILE ON INTERIOR SIDE AND NEW EXTERIOR GRADE SHEATHING PER STRUC. WITH (2) LAYERS CONTINUOUS WRB, AND 3 COAT ACRYLIC STUCCO ON SELF-FURRING LATH.

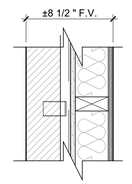
4E:
EXISTING WOOD WALL STUDS WITH NEW R-19 INSULATIONCEMENTITIOUS BACKERBOARD MORTAR AND TILE ON INTERIOR SIDE AND NEW EXTERIOR GRADE SHEATHING PER STRUC. WITH (2) LAYERS CONTINUOUS WRB, AND 3 COAT ACRYLIC STUCCO ON SELF-FURRING LATH.



5

STUCCO AND GYP CHASE

2 X 4 INTERIOR WOOD WALL STUDS WITH 1/2" GWB (TYPE X AT STORAGE AREAS) TEXTURED FINISH PER SPEC, 2 X 4 EXTERIOR WOOD STUDS WITH R-19 INSULATION AND EXTERIOR GRADE SHEATHING PER STRUCTURAL WITH (2) LAYERS CONTINUOUS WRB, AND 3 COAT ACRYLIC STUCCO ON SELF-FURRING LATH.

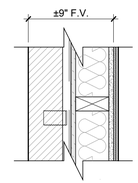


6 6E

BRICK AND GWB

6:
2 X 4 WOOD WALL STUDS WITH R-19 INSULATION 1/2" GWB ON INTERIOR SIDE, TEXTURED FINISH PER SPEC, AND EXTERIOR GRADE SHEATHING PER STRUCTURAL WITH (1) LAYER CONTINUOUS WRB, AIRSPACE, AND BRICK VENEER W/ MASONRY TIES @ 16" O.C. VERT. AND 32" O.C. HORIZ.

6E:
EXISTING WOOD WALL STUDS WITH NEW R-19 INSULATION AND NEW 1/2" GWB ON INTERIOR SIDE, TEXTURED FINISH PER SPEC, AND EXISTING EXTERIOR GRADE SHEATHING WITH (1) LAYER CONTINUOUS WRB, AIRSPACE, AND BRICK VENEER W/ MASONRY TIES @ 16" O.C. VERT. AND 32" O.C. HORIZ.

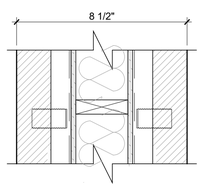


7 7E

BRICK AND TILE

7:
2 X 4 WOOD WALL STUDS WITH R-19 INSULATION CEMENTITIOUS BACKERBOARD MORTAR AND TILE ON INTERIOR SIDE AND EXTERIOR GRADE SHEATHING PER STRUCTURAL WITH (1) LAYER CONTINUOUS WRB, AIRSPACE, AND BRICK VENEER W/ MASONRY TIES @ 16" O.C. VERT. AND 32" O.C. HORIZ.

7E:
EXISTING WOOD WALL STUDS WITH NEW R-19 INSULATION NEW CEMENTITIOUS BACKERBOARD MORTAR AND NEW TILE ON INTERIOR SIDE AND EXISTING EXTERIOR GRADE SHEATHING WITH (1) LAYER CONTINUOUS WRB, AIRSPACE, AND BRICK VENEER W/ MASONRY TIES @ 16" O.C. VERT. AND 32" O.C. HORIZ.

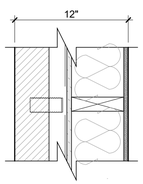


8

BRICK AND BRICK

2 X 6 WOOD WALL STUDS WITH R-19 INSULATION AND EXTERIOR GRADE SHEATHING PER STRUCTURAL WITH (1) LAYER CONTINUOUS WRB, AIRSPACE, AND BRICK VENEER W/ MASONRY TIES @ 16" O.C. VERT. AND 32" O.C. HORIZ. BOTH SIDES

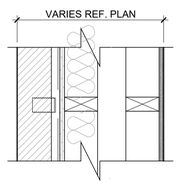
EXTERIOR WALL TYPES - CONT.



9

BRICK AND GYP

2 X 6 INTERIOR WOOD WALL STUDS WITH 1/2" GWB (TYPE X AT STORAGE AREAS) TEXTURED FINISH PER SPEC, WITH R-19 INSULATION AND EXTERIOR GRADE SHEATHING PER STRUCTURAL WITH (1) LAYERS CONTINUOUS WRB, AND AIRSPACE, AND BRICK VENEER W/ MASONRY TIES @ 16" O.C. VERT. AND 32" O.C. HORIZ. BOTH SIDES

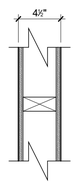


10

BRICK AND GYP CHASE

2 X 4 INTERIOR WOOD WALL STUDS WITH 1/2" GWB (TYPE X AT STORAGE AREAS) TEXTURED FINISH PER SPEC, 2 X 4 EXTERIOR WOOD STUDS WITH R-19 INSULATION AND EXTERIOR GRADE SHEATHING PER STRUCTURAL WITH (1) LAYERS CONTINUOUS WRB, AND AIRSPACE, AND BRICK VENEER W/ MASONRY TIES @ 16" O.C. VERT. AND 32" O.C. HORIZ. BOTH SIDES

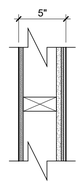
INTERIOR WALL TYPES



11

2 X 4 GWB

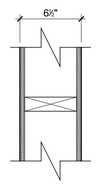
2 X 4 INTERIOR WOOD STUD WALL WITH 1/2" GWB ON EACH SIDE, TEXTURED FINISH PER SPEC. PROVIDE INSULATION PER ENERGY CODE IN ALL WALLS BORDERING NON-AC SPACES SEPARATION PER IRC AT GARAGE



12

2 x 4 GWB AND TILE

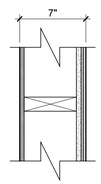
2 X 4 INTERIOR WOOD STUD WALL WITH 1/2" GWB ONE SIDE, TEXTURED FINISH PER SPEC, WITH CEMENTITIOUS BACKERBOARD MORTAR AND TILE ON BATH SIDE. PROVIDE INSULATION PER ENERGY CODE IN ALL WALLS BORDERING NON-AC SPACES.



13

2 X 6 GWB

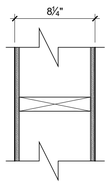
2 X 6 INTERIOR WOOD STUD WALL WITH 1/2" GWB ON EACH SIDE, TEXTURED FINISH PER SPEC. PROVIDE INSULATION PER ENERGY CODE IN ALL WALLS BORDERING NON-AC SPACES SEPARATION PER IRC AT GARAGE



14

2 x 6 GWB AND TILE

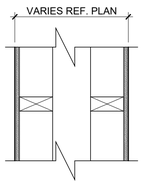
2 X 6 INTERIOR WOOD STUD WALL WITH 1/2" GWB ONE SIDE, TEXTURED FINISH PER SPEC, WITH CEMENTITIOUS BACKERBOARD MORTAR AND TILE ON BATH SIDE. PROVIDE INSULATION PER ENERGY CODE IN ALL WALLS BORDERING NON-AC SPACES.



15

2 X 8 GWB

2 X 8 INTERIOR WOOD STUD WALL WITH 1/2" GWB ON EACH SIDE, TEXTURED FINISH PER SPEC. PROVIDE INSULATION PER ENERGY CODE IN ALL WALLS BORDERING NON-AC SPACES SEPARATION PER IRC AT GARAGE



16

2 X CHASE GWB

2 X INTERIOR WOOD STUD WALL WITH 1/2" GWB ON ONE SIDE, TEXTURED FINISH PER SPEC. PROVIDE INSULATION PER ENERGY CODE IN ALL WALLS BORDERING NON-AC SPACES SEPARATION PER IRC AT GARAGE

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06/19/2025 REGISTERED ARCHITECT ALICE ARTERBERRY 26018 STATE OF TEXAS

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Project Address:
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West Lake Hills 78746

Contractor:
Captex Construction

WALL TYPES

drawn by: MJS
checked by: NS
scale: 1 1/2" = 1'-0"
first issue: 06/19/2025
plot date: 06/19/2025

PERMIT SET

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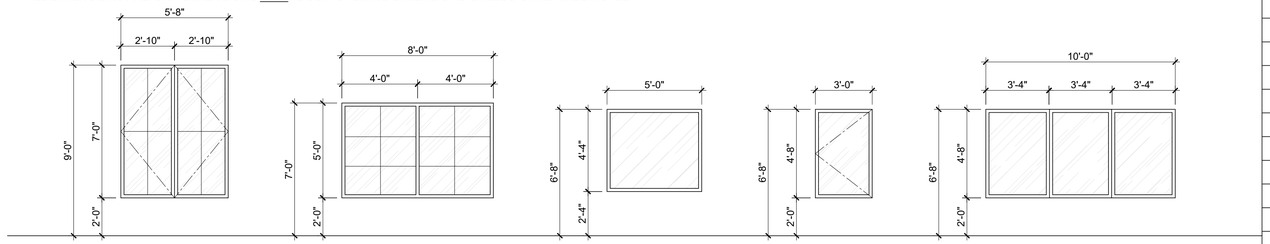
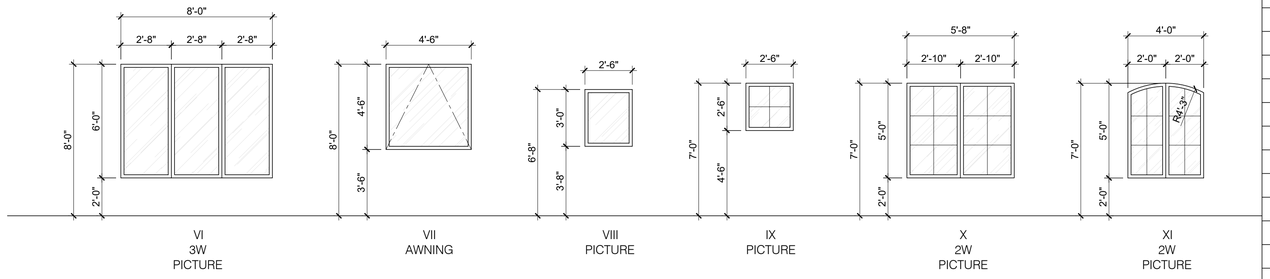
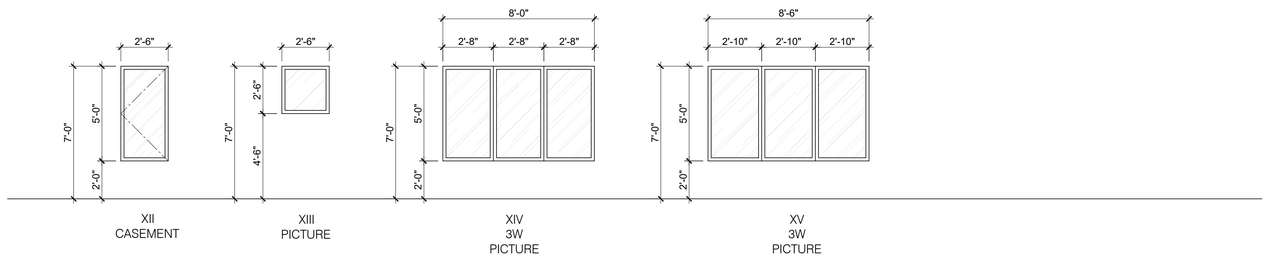
WINDOW TYPES

- SCALE 1/4" = 1'-0" (TABLOID SCALE: 1/8" = 1'-0")
- MIN 5.7 SQFT SECONDARY EXIT FROM EACH BEDROOM W. MIN 20" WIDTH AND 24" HEIGHT CLEAR OPENING
- GLASS TO BE TEMPERED PER IRC 308.4
- ALL DIMENSIONS ARE UNIT DIMENSIONS NOT ROUGH OPENING DIMENSIONS UNLESS OTHERWISE NOTED







WINDOW SCHEDULE

MARK	TYPE	SIZE W	SIZE H	HEAD HGT	TYPE	REMARKS
A	I	5'-8"	7'-0"	9'-0"	PICTURE	TEMPERED GLASS, OBSCURE GLASS, DEEP SET DETAIL
B	I	5'-8"	7'-0"	9'-0"	CASEMENT	DEEP SET DETAIL
C	II	8'-0"	5'-0"	7'-0"	PICTURE	OBSCURE GLASS, BACK FRAMED
D	III	5'-0"	4'-4"	6'-8"	PICTURE	TEMPERED GLASS, OBSCURE GLASS
E	IV	3'-0"	4'-8"	6'-8"	CASEMENT	
F	IV	3'-0"	4'-8"	6'-8"	CASEMENT	EGRESS
G	V	10'-0"	4'-8"	6'-8"	PICTURE	
H	VI	8'-0"	6'-0"	8'-0"	PICTURE	
I	VII	4'-6"	4'-6"	8'-0"	AWNING	
J	VIII	2'-6"	3'-0"	6'-8"	PICTURE	
K	IX	2'-6"	2'-6"	7'-0"	PICTURE	
L	X	5'-8"	5'-0"	7'-0"	PICTURE	DEEP SET DETAIL
M	XI	4'-0"	6'-0"	7'-0"	PICTURE	BACK-FRAMED OBSCURE GLASS, DEEP SET DETAIL
N	X	5'-8"	5'-0"	7'-0"	PICTURE	DEEP SET DETAIL
O	XII	2'-6"	5'-0"	7'-0"	CASEMENT	
P	XII	2'-6"	5'-0"	7'-0"	CASEMENT	EGRESS
Q	XIII	2'-6"	2'-6"	7'-0"	PICTURE	
R	XII	2'-6"	5'-0"	7'-0"	CASEMENT	EGRESS
S	XII	2'-6"	5'-0"	7'-0"	CASEMENT	
T	XIV	8'-0"	5'-0"	7'-0"	PICTURE	
U	XV	8'-6"	5'-0"	7'-0"	PICTURE	
V	XIV	8'-0"	5'-0"	7'-0"	PICTURE	
W	XII	2'-6"	5'-0"	7'-0"	CASEMENT	
X	XII	2'-6"	5'-0"	7'-0"	CASEMENT	EGRESS

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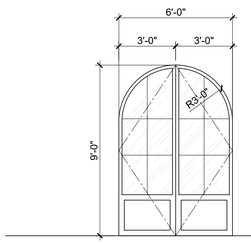
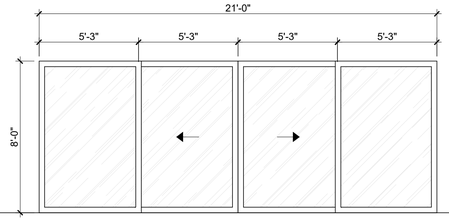
- ALL EXTERIOR DOORS SHALL HAVE WEATHER-TIGHT THRESHOLDS WITH BLACK WEATHER-STRIPPING
- ALL EXTERIOR DOORS SHALL BE INSULATED
- ALL INTERIOR DOORS SHALL BE SOLID CORE
- ALL DIMENSIONS ARE UNIT DIMENSIONS NOT ROUGH OPENING DIMENSIONS UNLESS OTHERWISE NOTED.

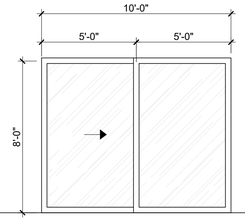
EXTERIOR DOORS TYPES



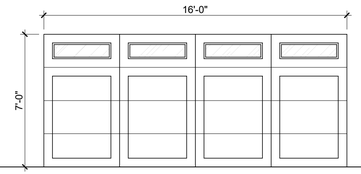
I
EXTERIOR ARCHED
SWING ENTRY PAIR



II
EXTERIOR SLIDE ENTRY

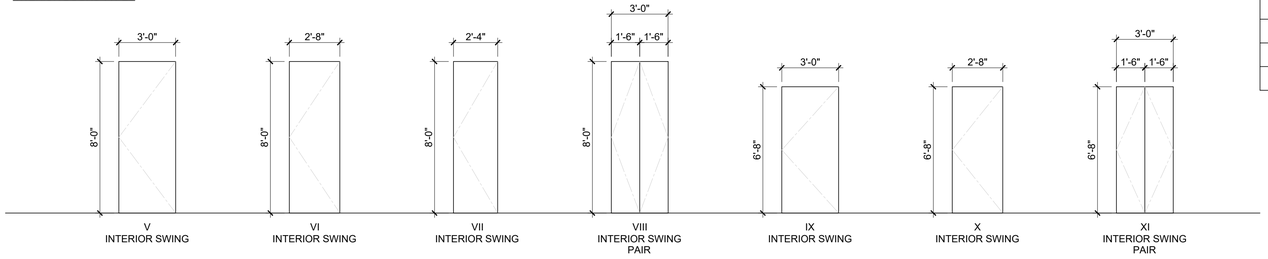


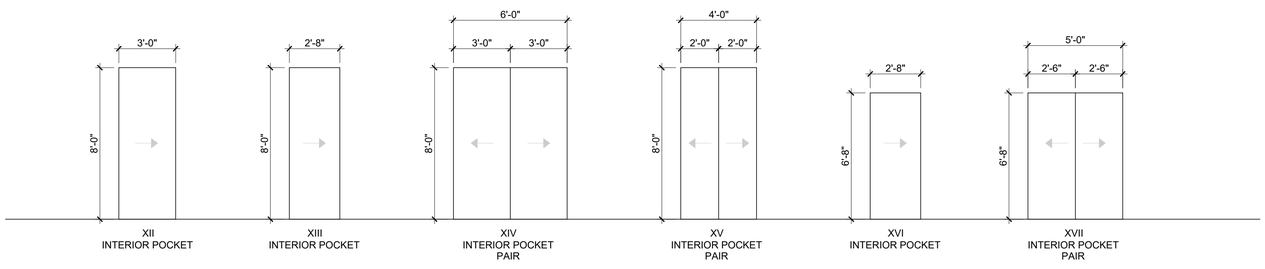
III
EXTERIOR SLIDE ENTRY



IV
2 CAR GARAGE
DOOR

INTERIOR DOORS TYPES





DOOR SCHEDULE

MARK	TYPE	SIZE			MATERIAL	TYPE	FUNCTION	REMARKS
		W	H	THK				
1	IV	16'-0"	7'-0"	1 3/4"	MTL./INSUL.	OVHD	UTILITY	GARAGE DOOR WITH REMOTE OPENER
2	I	6'-0"	9'-0"	1 3/4"	MTL./INSUL.	SWING	ENTRY	ARCHED DOOR PAIR, TEMPERED GLASS
3	II	21'-0"	8'-0"	1 3/4"	MTL./INSUL.	SLIDE	ENTRY	TEMPERED GLASS
4	III	10'-0"	8'-0"	1 3/4"	MTL./INSUL.	SLIDE	ENTRY	TEMPERED GLASS
5	VII	2'-4"	8'-0"	1 3/4"	MDF	SWING	PASSAGE	
6A	XVII	5'-0"	6'-8"	1 3/4"	MDF	POCKET	PASSAGE	
6B	X	2'-8"	6'-8"	1 3/4"	MDF	SWING	PRIVACY	
7	XI	3'-0"	6'-8"	1 3/4"	MDF	SWING	PASSAGE	
8	X	2'-8"	6'-8"	1 3/4"	MDF	SWING	PASSAGE	
9	XI	3'-0"	6'-8"	1 3/4"	MDF	SWING	PASSAGE	
10	X	2'-8"	6'-8"	1 3/4"	MDF	SWING	PRIVACY	
11	VIII	3'-0"	8'-0"	1 3/4"	MDF	SWING	PASSAGE	
12	XII	3'-0"	8'-0"	1 3/4"	MDF	POCKET	PASSAGE	
13	XIV	6'-0"	8'-0"	1 3/4"	MDF	POCKET	PASSAGE	
14	IX	3'-0"	6'-8"	1 3/4"	MDF	SWING	ENTRY	DOOR TO MEET R302.6 REQUIREMENTS
15	XVI	3'-0"	6'-8"	1 3/4"	MDF	POCKET	PASSAGE	
16	VI	2'-8"	8'-0"	1 3/4"	MDF	SWING	PASSAGE	
17	VI	2'-8"	8'-0"	1 3/4"	MDF	SWING	PRIVACY	
18	VI	2'-8"	8'-0"	1 3/4"	MDF	SWING	PRIVACY	
19	XV	4'-0"	8'-0"	1 3/4"	MDF	POCKET	PASSAGE	
20	VI	2'-8"	8'-0"	1 3/4"	MDF	SWING	PRIVACY	
21	VI	2'-8"	8'-0"	1 3/4"	MDF	SWING	PASSAGE	
22	XIII	2'-8"	8'-0"	1 3/4"	MDF	POCKET	PASSAGE	
23	VI	2'-8"	8'-0"	1 3/4"	MDF	SWING	PRIVACY	
24	VI	2'-8"	8'-0"	1 3/4"	MDF	SWING	PASSAGE	
25	XIII	2'-8"	8'-0"	1 3/4"	MDF	POCKET	PASSAGE	

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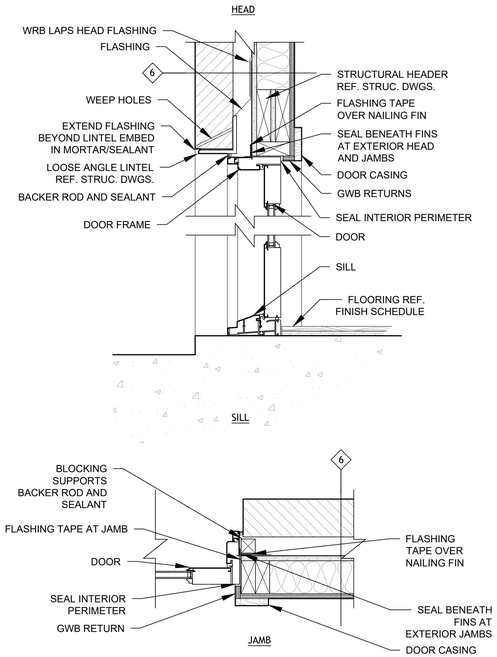
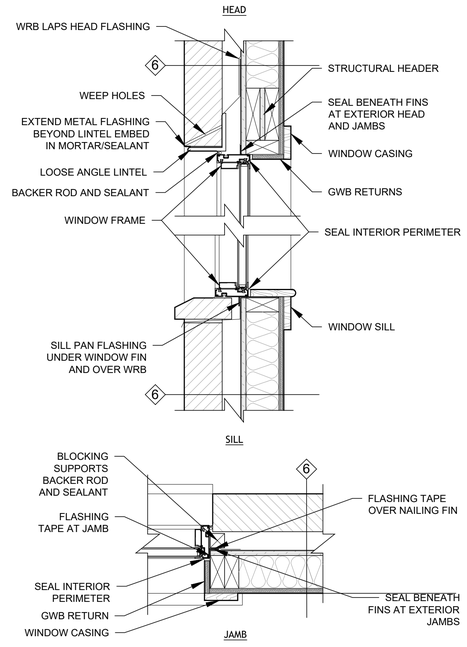


SWING DOOR @ MASONRY

Scale 1 1/2" = 1'-0" (TABLOID:Scale 3/4" = 1'-0")

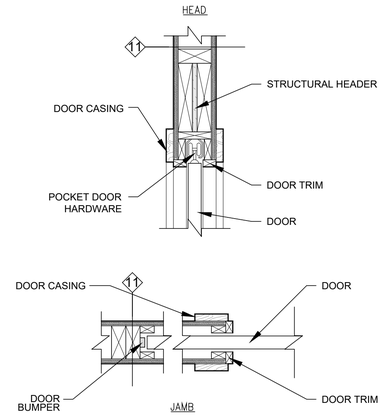
1



WINDOW DETAIL @ MASONRY

Scale 1 1/2" = 1'-0" (TABLOID:Scale 3/4" = 1'-0")

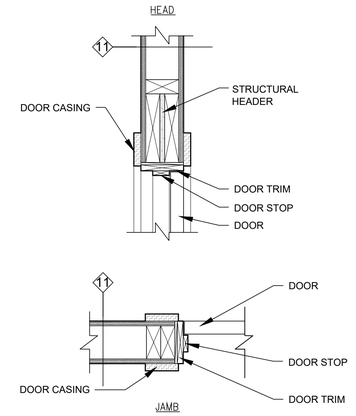
2



POCKET DOOR @ INTERIOR

Scale 1 1/2" = 1'-0" (TABLOID:Scale 3/4" = 1'-0")

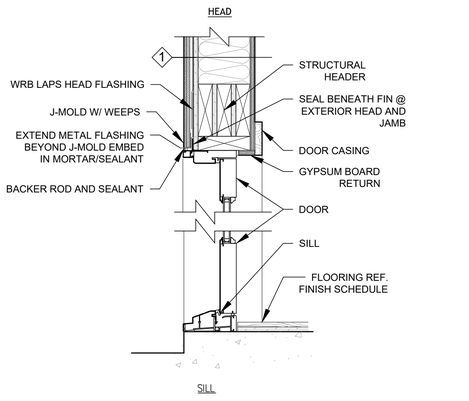
3



SWING DOOR @ INTERIOR

Scale 1 1/2" = 1'-0" (TABLOID:Scale 3/4" = 1'-0")

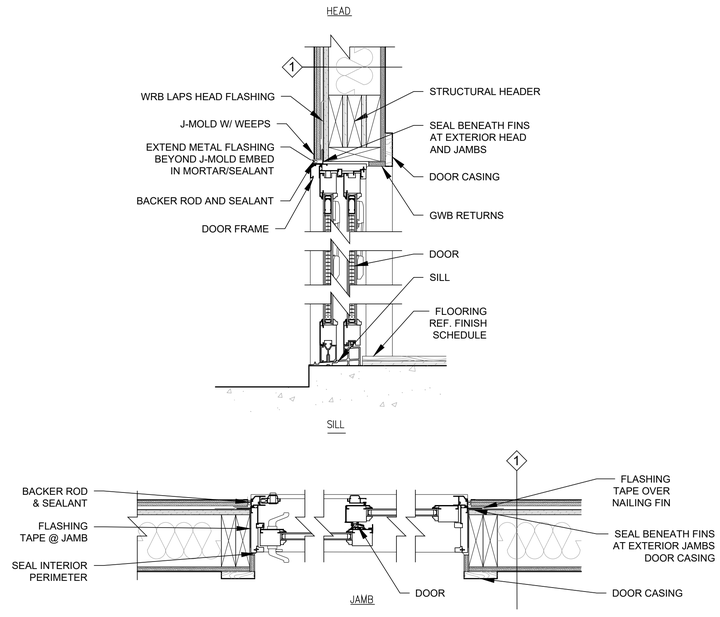
4



SWING DOOR @ STUCCO

Scale 1 1/2" = 1'-0" (TABLOID:Scale 3/4" = 1'-0")

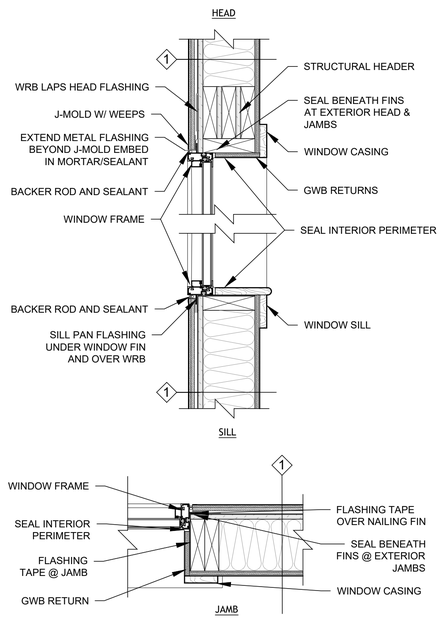
5



SLIDING DOOR @ SIDING

Scale 1 1/2" = 1'-0" (TABLOID:Scale 3/4" = 1'-0")

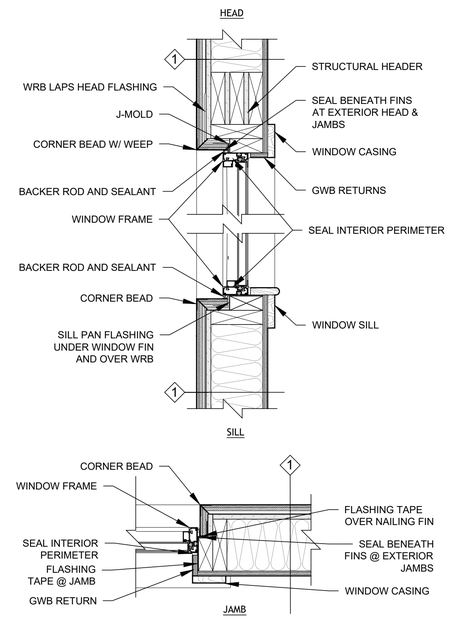
6



WINDOW DETAIL @ STUCCO - FLUSH SET

Scale 1 1/2" = 1'-0" (TABLOID:Scale 3/4" = 1'-0")

7



WINDOW DETAIL @ STUCCO - DEEP SET

Scale 1 1/2" = 1'-0" (TABLOID:Scale 3/4" = 1'-0")

8

Revisions By

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DOOR & WINDOW DETAILS

drawn by: MJS
checked by: NS
scale: 1 1/2" = 1'-0"
first issue: 06/19/2025
plot date: 06/19/2025

PERMIT SET

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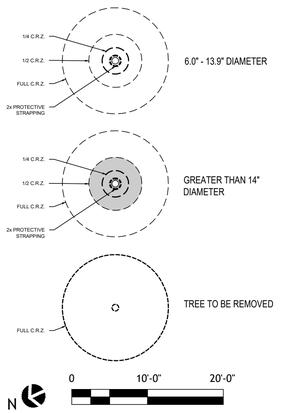
EXISTING AREA CALCULATIONS

RESIDENCE (INCLUDING GARAGE)	2,400 SQFT
COVERED PORCH	81 SQFT
DRIVEWAY	751 SQFT
SIDEWALKS AND PATIOS	624 SQFT
EQUIPMENT PADS/MISC FLATWORK	19 SQFT
SHED	65 SQFT
TOTAL AREA	3,940 SQFT
LOT AREA	11,798 SQFT
IMPERVIOUS COVER	3,940 SQFT
PERCENTAGE OF IC	33.4%
ALLOWABLE IC	36.5% (4,306.27 SQFT)

LEGEND

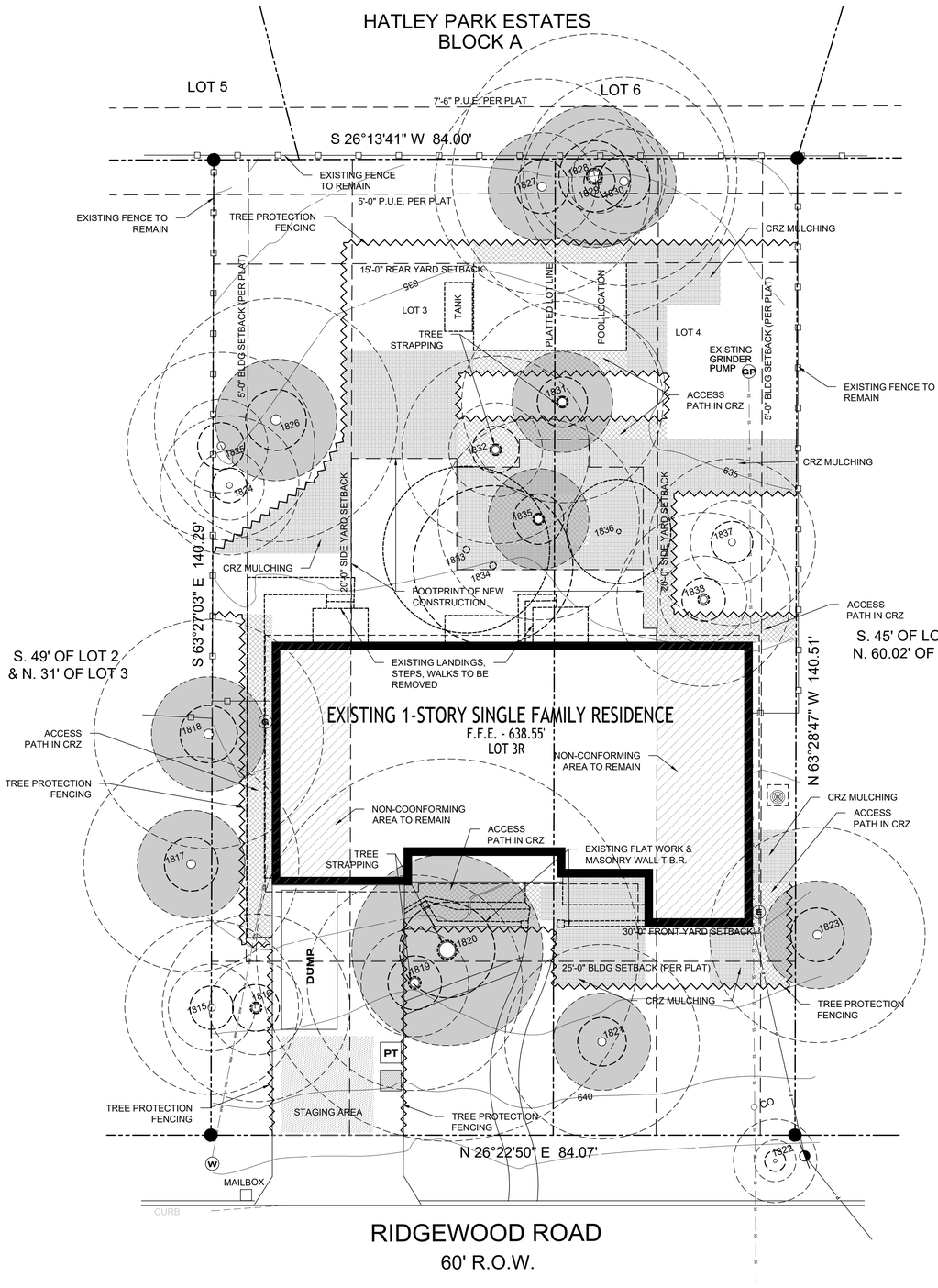
- STAGING AREA
- ROOF OUTLINE
- SETBACK / EASEMENT
- PROPERTY LINE
- WOOD FENCING
- TREE PROTECTIVE FENCING
- DUMP — DUMPSTER / SPOILS
- WASHOUT(S)
- PT — PORTABLE TOILET
- SS — WASTE WATER
- GAS — GAS LINE
- WW — WATER LINE
- UE — UNDERGROUND ELEC
- OVERHEAD POWER
- PROTECTIVE MULCHING
- ACCESS PATH WITHIN CRZ
- W G E — WATER, GAS, POWER UTILITY METERS
- F.F.E. — FINISH FLOOR ELEVATION
- AIR CONDITIONER
- POOL EQUIPMENT

CRITICAL ROOT ZONES



NOTES:

- CONTRACTOR TO FIELD VERIFY LOCATION OF EXISTING UTILITIES
- PERMIT REQUIRED PRIOR TO REMOVAL OR PRUNING OF ANY TREE
- CONTRACTOR TO CALL FOR INSPECTION PRIOR TO REMOVAL OF ANY TREE OR BRANCH OF ANY SIZE FOR WHICH A PERMIT HAS NOT BEEN APPROVED FOR APPROVAL
- REFERENCE COWLH TREE NOTES FOR ADDITIONAL INFORMATION
- REFERENCE CIVIL DRAWINGS FOR EROSION AND SEDIMENTATION CONTROLS
- SEE LANDSCAPE PLANS FOR NEW TREES REQUIRED FOR MITIGATION OF TREE REMOVAL
- REFERENCE CIVIL DRAWINGS FOR IMPERVIOUS COVERAGE CALCULATIONS



DEMOLITION SITE PLAN

Scale 1" = 10'-0" (TABLOID:Scale 1" = 20'-0")

1

TREE CHART

TREE TAG NO.#	LOCATION	DIAMETER	SPECIES	STATUS	C.R.Z.	PROTECTION	MITIGATION INCHES
1815	SETBACK	12.5"	ELM	PROTECTED	12'-6"	F	
1816	SETBACK	13.5"	ELM	PROTECTED	13'-6"	F/S	
1817	NEIGHBOR	15.5"	ELM	PROTECTED	15'-6"	F/P	
1818	NEIGHBOR	16.5"	ELM	PROTECTED	16'-6"	F/P	
1819	SETBACK	15.5"	OAK	PROTECTED	15'-6"	F/S/P	
1820	SETBACK	27.5"	OAK	PROTECTED	27'-6"	F/S/M/P	
1821	SETBACK	14"	ELM	PROTECTED	14'-0"	F/M	
1822	NEIGHBOR	6"	CREPE MRTL	PROTECTED	6'-0"	F	
1823	NEIGHBOR	15.5"	ELM	PROTECTED	15'-6"	F/M/P	
1824	SETBACK	10"	ELM	PROTECTED	10'-0"	F/M	
1825	SETBACK	13.5"	ELM	PROTECTED	13'-6"	F/M	
1826	SETBACK	17.5"	ELM	PROTECTED	17'-6"	F/M	
1827	SETBACK	15.5"	OAK	PROTECTED	15'-6"	F/M/P	
1828	SETBACK	20.5"	PRIVET	PROTECTED	20'-6"	F/S/M/P	
1829	SETBACK	9"	ELM	PROTECTED	9'-0"	F/M/P	
1830	SETBACK	15"	ELM	PROTECTED	15'-0"	F/M/P	
1831	CONST	14.5"	ELM	PROTECTED	14'-6"	F/S/M/P	
1832	CONST	13.5"	ELM	PROTECTED	13'-6"	S/M/P	
1833	CONST	12"	ELM	TO BE REMOVED	12'-0"		9"
1834	CONST	11.5"	ELM	TO BE REMOVED	11'-6"		8.75"
1835	CONST	14.5"	ELM	PROTECTED	14'-6"	S/M/P	
1836	CONST	7.5"	ELM	TO BE REMOVED	7'-6"		5.75"
1837	SETBACK	12"	ELM	PROTECTED	12'-0"	F/M/P	
1838	SETBACK	12.5"	ELM	PROTECTED	12'-6"	F/M/P	

* PROTECTION:F - FENCING, S - STRAPPING, M - MULCHING, P - PROTECTIVE PATH

TREE ORDINANCE NOTES:

* A MINIMUM OF 50 PERCENT OF THE CRITICAL ROOT ZONE MUST BE PRESERVED AT NATURAL GRADE, WITH NATURAL GROUND COVER.
* THERE IS NO CUT OR FILL WITHIN THE 1/4 CRITICAL ROOT ZONES. NO IMPACTS ARE PERMITTED WITHIN THE 1/4 CRITICAL ROOT ZONE.
* PRIOR TO CONSTRUCTION, 5' HIGH CHAIN-LINK MESH, PROTECTIVE FENCING IS REQUIRED AROUND ALL TREES WITHIN THE LOC. WHEN THE PROTECTIVE FENCING CANNOT INCORPORATE THE ENTIRE ½ CRITICAL ROOT ZONE, AN 8" LAYER OF MULCH WITHIN THE ENTIRE AVAILABLE ROOT ZONE AREA IS REQUIRED FOR ALL TREES WHICH HAVE ANY DISTURBANCE INDICATED WITHIN ANY PORTION OF THE CRITICAL ROOT ZONE. ADDITIONALLY, MIN 2X4 OR GREATER SIZE PLANKS (6' TALL MINIMUM) TO BE STRAPPED SECURELY AROUND A PROTECTED TREE'S TRUNK AND ROOT FLARE WHEN PROTECTIVE FENCING DOESN'T INCORPORATE THE ENTIRE 1/2 CRZ FOR ANY REASON AT ANY TIME IN THE PROJECT.
* THERE IS NO CUT OR FILL 4" OR GREATER WITHIN THE ½ CRITICAL ROOT ZONE OF PROTECTED TREES. ONLY PIERS ARE ALLOWED WITHIN ½ CRITICAL ROOT ZONE AND PIERS MUST BE AIR-SPADED.
* DEMOLITION WITHIN THE 1/2 CRITICAL ROOT ZONE MUST BE ACCOMPLISHED WITH HAND TOOLS.
* NOT MORE THAN 25 PERCENT OF THE CROWN SHOULD BE REMOVED WITHIN AN ANNUAL GROWING SEASON, AND THAT THE PERCENTAGE AND DISTRIBUTION OF FOLIAGE TO BE REMOVED SHALL BE ADJUSTED ACCORDING TO THE PLANT'S SPECIES, AGE, HEALTH, AND SITE. IF ANY PRUNING IS REQUIRED, A CERTIFIED ARBORIST MUST PERFORM THE PRUNING AND PRUNING MAY ONLY HAPPEN ONCE DURING THE PROJECT DURATION. THIS SHOULD OCCUR PRIOR TO CONSTRUCTION TO AVOID DAMAGING THE TREES DURING CONSTRUCTION. A "PAID IN FULL" RECEIPT FROM A CERTIFIED ARBORIST, FOR THE WORK, WILL BE REQUIRED FROM THE FINAL TREE INSPECTOR. IF 25% OR MORE OF THE CANOPY IS DESIRED TO BE REMOVED, THE CERTIFIED ARBORIST MUST PROVIDE A WRITTEN REPORT TO US TO SEEK A PERMIT, BEFORE PERFORMING THIS WORK.)
* ACCESS ROUTES, MATERIAL STAGING, DUMPSTER AND SPOILS MAY NOT BE PLACED WITHIN A PROTECTED TREE'S 1/2 CRZ.
* PORTABLE TOILET, CONCRETE WASHOUT AND PAINT WASHOUT MAY NOT BE PLACED WITHIN A PROTECTED TREE'S FULL CRZ
* AVOID THE 1/2 CRITICAL ROOT ZONES OF PROTECTED TREES WITH ANY NEWLY PROPOSED UTILITY WORK. IF TRENCHING WITHIN THE ½ CRZ OF PROTECTED TREES CANNOT BE AVOIDED, THE TRENCHES WILL BE AIR SPACED BY A CERTIFIED ARBORIST FOR THE TOP 30" TO AVOID CUTTING ROOTS 1.5"+ IN DIAMETER AND THE PAID RECEIPT FOR THE WORK WILL BE REQUIRED BY THE FINAL TREE INSPECTOR.
* IF HEAVY EQUIPMENT WILL BE ROLLING OVER ANY AREA OF THE FULL CRZ OF PROTECTED TREES, PROVIDE 3/4" PLYWOOD OVER 2X4 LUMBER OVER 12" LAYER OF MULCH TO BRIDGE OVER THE ROOTS AND PREVENT SOIL/ROOT COMPACTION. AFTER CONSTRUCTION IS COMPLETED, SPREAD MULCH AROUND SITE TO LEAVE A MAX LAYER OF 3" WITHIN ROOT ZONES.

Revisions By

ARTERBERRY COOKE architecture

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323.236.5182

REGISTERED ARCHITECT ALICE ARTERBERRY 26018 STATE OF TEXAS 06/19/2025

Project Owner:
Michelle and David Ewart
3806 Meandering Creek Cv
Austin TX 78746

Project Address:
419 Ridgewood Rd
West Lake Hills 78746

Contractor:
Captex Construction

SITE DEMOLITION PLAN

drawn by: MJS
checked by: NS
scale: 1" = 10'-0"
first issue: 06/19/2025
plot date: 06/19/2025

PERMIT SET

A1.0

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PROPOSED AREA CALCULATIONS

IMPERVIOUS COVER	
RESIDENCE	2,555 SQFT
ATTACHED GARAGE	538 SQFT
COVERED PORCH	78 SQFT
PERMEABLE DRIVEWAY (75%)	521 SQFT
WOOD DECK (50%)	224 SQFT
EQUIPMENT PADS/MISC FLATWORK	104 SQFT
POOL	161 SQFT
SPA	36 SQFT
POOL COPING	78 SQFT
TOTAL AREAS	4,295 SQFT

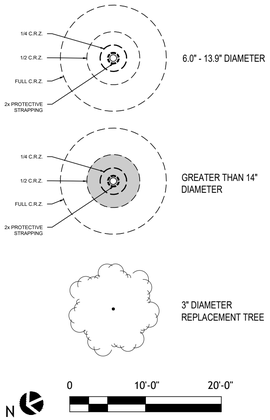
LOT AREA	11,798 SQFT
IMPERVIOUS COVER	4,295 SQFT
PERCENTAGE OF IC	36.4%
ALLOWABLE IC	36.5% (4306.27 SQFT)

CONDITIONED AREA	
FIRST FLOOR	2,555 SQFT
SECOND FLOOR	1,544 SQFT
TOTAL AREA	4,099 SQFT

LEGEND

- STAGING AREA
- ROOF OUTLINE
- SETBACK / EASEMENT
- PROPERTY LINE
- WOOD FENCING
- TREE PROTECTIVE FENCING
- DUMP — DUMPSTER / SPOILS
- WASHOUT(S)
- PT — PORTABLE TOILET
- SS — WASTE WATER
- GAS — GAS LINE
- WW — WATER LINE
- UE — UNDERGROUND ELEC
- OVERHEAD POWER
- PROTECTIVE MULCHING
- 4'-0" WIDE ACCESS PATH WITHIN CRZ
- W G E — WATER, GAS, POWER UTILITY METERS
- F.F.E. — FINISH FLOOR ELEVATION
- AIR CONDITIONER
- POOL EQUIPMENT

CRITICAL ROOT ZONES



NOTES:

- CONTRACTOR TO FIELD VERIFY LOCATION OF EXISTING UTILITIES
- PERMIT REQUIRED PRIOR TO REMOVAL OR PRUNING OF ANY TREE
- CONTRACTOR TO CALL FOR INSPECTION PRIOR TO REMOVAL OF ANY TREE OR BRANCH OF ANY SIZE FOR WHICH A PERMIT HAS NOT BEEN APPROVED FOR APPROVAL
- REFERENCE COWLH TREE NOTES FOR ADDITIONAL INFORMATION
- REFERENCE CIVIL DRAWINGS FOR EROSION AND SEDIMENTATION CONTROLS
- SEE LANDSCAPE PLANS FOR NEW TREES REQUIRED FOR MITIGATION OF TREE REMOVAL
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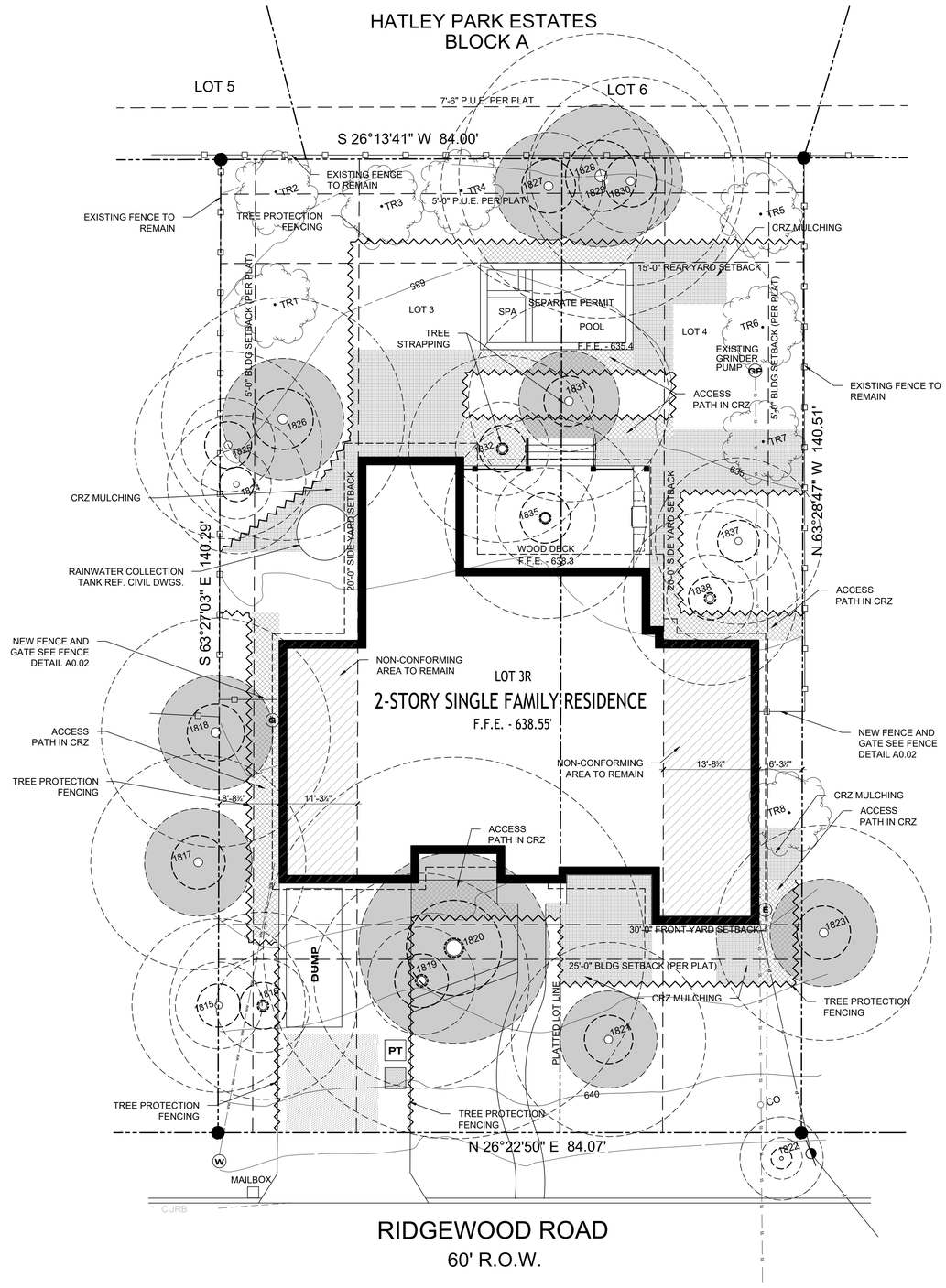

SITE PLAN

Scale 1" = 10'-0" (TABLOID:Scale 1" = 20'-0") 1

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TREE TAG NO.#	DIAMETER	SPECIES	MITIGATION
TR1	3"	TBD	TO MITIGATE THE REMOVAL OF TREES 1833, 1834, AND 1836, WE PROPOSE MITIGATION WITH (8) 3"D TREES ALL MITIGATION TREES TO BE CHOSEN FROM CITY OF WEST LAKE HILLS TREE ORDINANCE APPENDIX A. TOTAL REPLACEMENT INCHES IS 24"
TR2	3"	TBD	
TR3	3"	TBD	
TR4	3"	TBD	
TR5	3"	TBD	
TR6	3"	TBD	
TR7	3"	TBD	
TR8	3"	TBD	

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Revisions By

ARTERBERRY COOKE architecture

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REGISTERED ARCHITECT ALICE ARTERBERRY 06/19/2025 STATE OF TEXAS 26014

Project Owner:
Michelle and David Ewart
3806 Meandering Creek Cv
Austin TX 78746

Project Address:
419 Ridgewood Rd
West Lake Hills 78746

Contractor:
Captex Construction

SITE PLAN

drawn by: MJS
checked by: NS
scale: 1" = 10'-0"
first issue: 06/19/2025
plot date: 06/19/2025

PERMIT SET

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LEGEND

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- SETBACK / EASEMENT
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- SS — WASTE WATER
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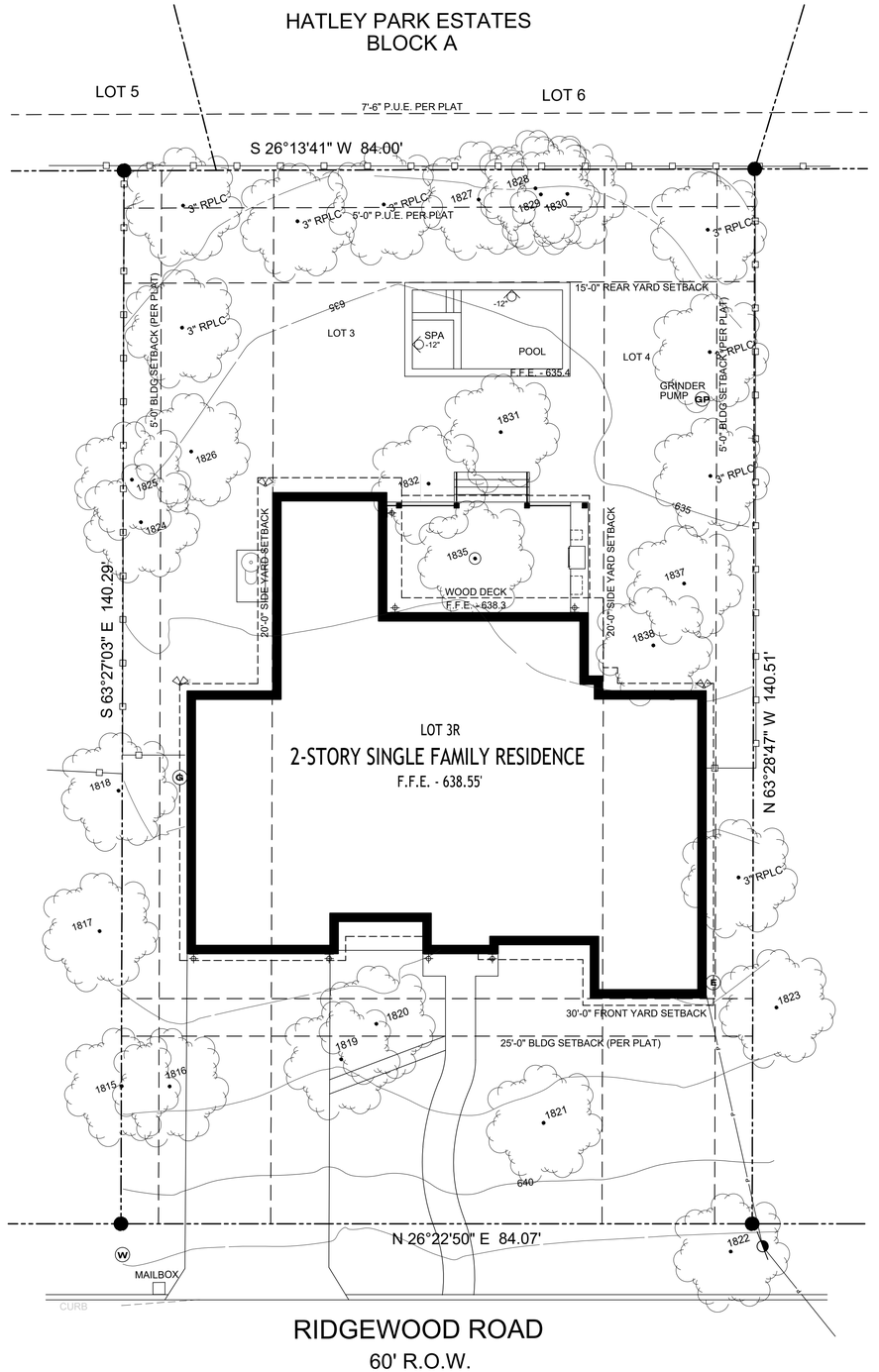
- WW — WATER LINE
- UE — UNDERGROUND ELEC
- OVERHEAD POWER
- (W) (G) (E) WATER, GAS, POWER UTILITY METERS
- F.F.E. FINISH FLOOR ELEVATION
- AIR CONDITIONER
- POOL EQUIPMENT
- TREE

N

0 10'-0" 20'-0"



SITE PLAN

Scale 1" = 10'-0" (TABLOID:Scale 1" = 20'-0")

1

LEGEND

- WALL-MOUNTED LIGHT FIXTURE
- POOL LIGHT FIXTURE
- CEILING-MOUNTED PENDANT LIGHT FIXTURE
- 4" (UNO) RECESSED CAN LIGHT FIXTURE (MUST SUPPORT LED LIGHTS)
- SECURITY FLOOD LIGHT

ELECTRICAL GENERAL NOTES:

OUTDOOR LIGHTING TO COMPLY WITH C OF WLH ORDINANCE 24.03.005 STANDARDS FOR R-1, R-2, AND R-3 RESIDENTIAL DISTRICTS. SEE E1.0-E1.2 FOR LIGHTING PLANS

CONTRACTOR SHALL REVIEW THE CONSTRUCTION DOCUMENTS AND PROVIDE LABOR AND MATERIALS PERTAINING TO THE ELECTRICAL SYSTEM AS REQUIRED IN CONSTRUCTION DOCUMENTS WHILE COMPLYING WITH ALL APPLICABLE BUILDING CODES, LOCAL UTILITY REQUIREMENTS AND BUILDING RESTRICTIONS.

LIGHT SWITCHES AND ENVIRONMENTAL CONTROLS SHALL BE A MAXIMUM OF 48 INCHES ABOVE THE FLOOR. THIS MEASUREMENT IS FROM THE TOP OF THE DEVICE OR BOX TO THE UNFINISHED FLOOR AT ROUGH INSPECTION.

OUTLETS MUST BE A MINIMUM OF 15 INCHES ABOVE THE FLOOR. THIS MEASUREMENT IS FROM THE BOTTOM OF THE DEVICE OR BOX TO THE UNFINISHED FLOOR AT ROUGH INSPECTION. FLOOR OUTLETS ARE AN ACCEPTABLE ALTERNATIVE WHERE INSTALLATION OF COMPLIANT WALL OUTLETS IS NOT FEASIBLE.

PROVIDE SMOKE ALARMS - HARD WIRED, INTERCONNECTED, BATTERY BACKUP, AT EACH SLEEPING ROOM AND IMMEDIATE COMMON AREA OUTSIDE OF SLEEPING ROOMS. IF APPLICABLE, ON EACH ADDITIONAL STORY INCLUDING BASEMENTS AND HABITABLE ATTICS. IN ACCORDANCE WITH IRC SEC R314
PROVIDE CARBON MONOXIDE ALARM - HARD WIRED WITH BATTERY BACKUP, INSTALLED OUTSIDE OF EACH SEPARATE SLEEPING AREA IN THE IMMEDIATE VICINITY OF THE BEDROOMS IN DWELLING UNITS WITHIN WHICH FUEL-FIRED APPLIANCES ARE INSTALLED AND/OR HAVE AN ATTACHED GARAGE. IN ACCORDANCE WITH IRC SEC R315"

ALL LIGHT FIXTURES LED OR HIGH EFFICACY U.N.O.

AT LEAST ONE 20 AMP BRANCH CIRCUIT SHALL BE PROVIDED TO SUPPLY BATHROOM RECEPTACLE OUTLETS. SUCH CIRCUITS SHALL HAVE NO OTHER OUTLETS.

OUTDOOR LIGHTING- ALL LUMINARIES MOUNTED TO THE BUILDING SHALL BE HIGH EFFICACY OR SHALL BE CONTROLLED BY A PHOTO-CONTROL / MOTION SENSOR.

ALL LIGHTS RECESSED INTO INSULATED CEILINGS MUST BE APPROVED FOR ZERO CLEARANCE INSULATION COVER (IC) AND ARE CERTIFIED AIRTIGHT TO ASTM E283 AND LABELED AS AIRTIGHT (AT) TO LESS THAN 2.0 CFM @ 75 PASCALS.

ALL CEILING FANS WITH LIGHT KITS SHALL HAVE SEPARATE SWITCHES FOR LIGHTS AND FAN CONTROL.

SITE AREA	11,798.67 SQFT	0.27 ACRES
EXTERIOR DOORS	3	
PERIMETER HOUSE	283'-9"	

LUMEN ALLOWANCE LIMIT = 15,237					
	QUANTITY	UNIT	ALLOWANCE/UNIT	TOTAL LUMENS	
LOT LESS THAN 1 ACRE	1	LOT	10000	10000	
DOOR ALLOWANCE	3	DOOR	800	2400	
PERIMETER ALLOWANCE	283.75	LNFT	10	2837.5	

LOCATION	MANU	MODEL	QUANTITY	LUMENS/ FIXTURE	TOTAL LUMENS	MOUNTING HEIGHT	CUT SHEET
ENTRY	VIS COMF	HALLE Lrg	2	450	900	8'-0"	WALL SCONCE
GARAGE DOOR	VIS COMF	HALLE Med	2	450	900	8'-0"	WALL SCONCE
DECK	VIS COMF	HALLE Med	3	450	1350	8'-0"	WALL SCONCE
POOL	PENTAIR	INTELLIBRITE	1	1,000	1,000	1'-0" BELOW WL	POOL
SPA	PENTAIR	INTELLIBRITE	1	400	400	1'-0" BELOW WL	SPA
SECURITY	GLOBE	ARCHITECTURAL	3	2000	6,000	9'-6" (Eave)	SECURITY
				TOTAL	10,550		

Revisions By

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06/19/2025
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STATE OF TEXAS
26018

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Captex Construction

SITE LIGHTING PLAN

drawn by: MJS
checked by: NS
scale: 1" = 10'-0"
first issue: 06/19/2025
plot date: 06/19/2025

PERMIT SET

A1.2

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GENERAL NOTES:

PREPARE EXISTING RESIDENCE FOR DEMOLITION AND NEW CONSTRUCTION. SUPPORT EXISTING STRUCTURE TO REMAIN AS REQUIRED PRIOR TO DEMOLITION.

DEMO ALL WINDOWS AND DOORS.

REMOVE EXTERIOR SIDING AND PREPARE EXISTING SHEATHING AS REQUIRED FOR NEW EXTERIOR FINISHES

DEMO EXISTING WALLS ACCORDING TO PLAN. AS WELL AS ALL INTERIOR CEILINGS, WALLS, FLOOR FINISHES, FIXTURES, COUNTERTOPS AND CABINETRY TO PREPARE FOR THE NEW CONSTRUCTION.

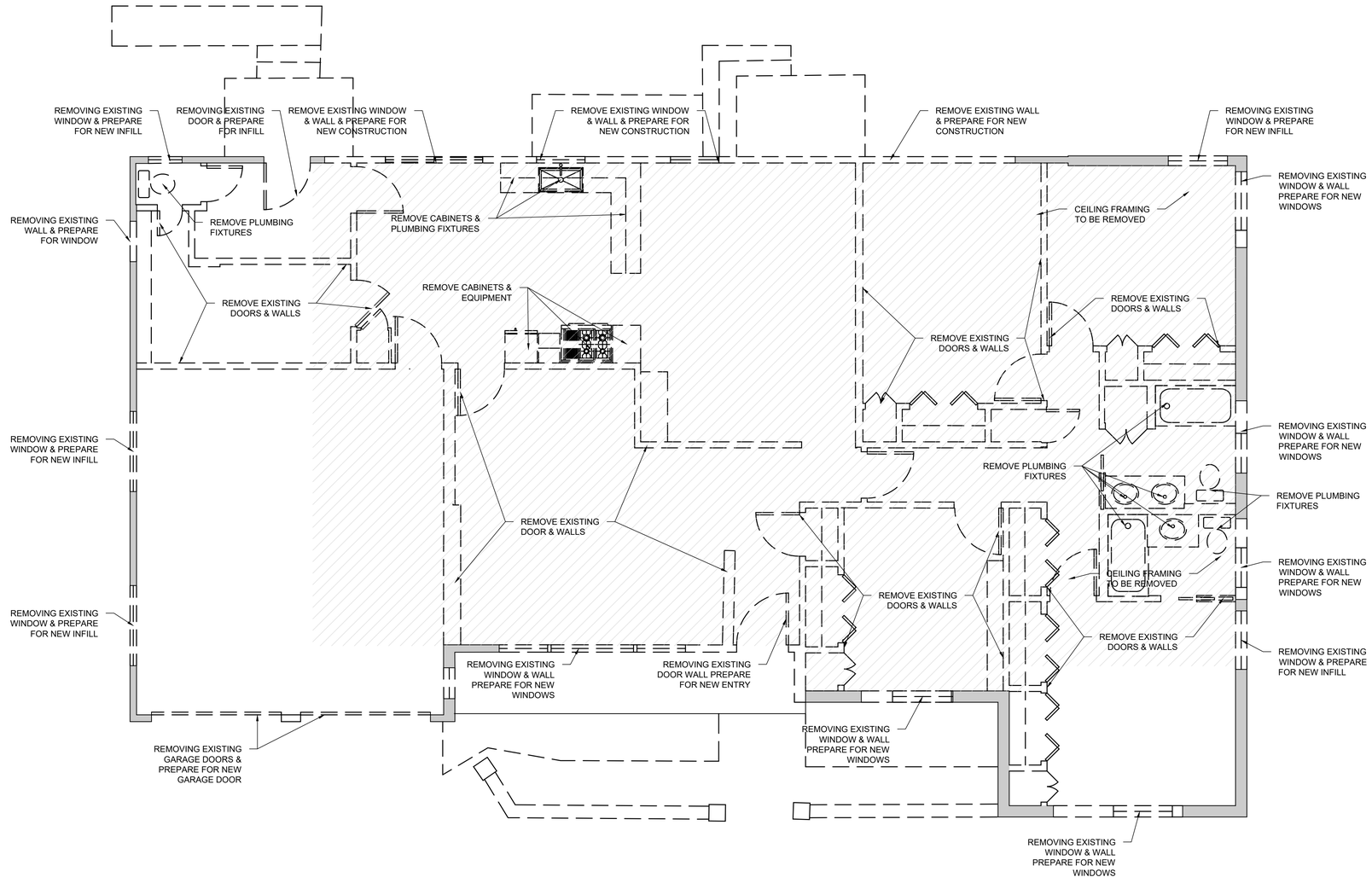
THE CONTRACTOR IS TO CAP AND PROTECT ALL UTILITIES AS REQUIRED TO MEET CODE REQUIREMENTS.

REMOVE EXISTING EQUIPMENT, FIXTURES, WIRING, AND PIPING NOT BEING REUSED.

PLAN LEGEND

EXISTING CONSTRUCTION TO REMAIN

EXISTING CEILING STRUCTURE TO BE REMOVED



DEMOLITION PLAN

1

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

Revisions By

ARTERBERRY COOKE architecture

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06/19/2025
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1ST FLOOR DEMOLITION PLAN

drawn by: MJS
checked by: NS
scale: 1/4" = 1'-0"
first issue: 06/19/2025
plot date: 06/19/2025

PERMIT SET

A2.0

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GENERAL NOTES:

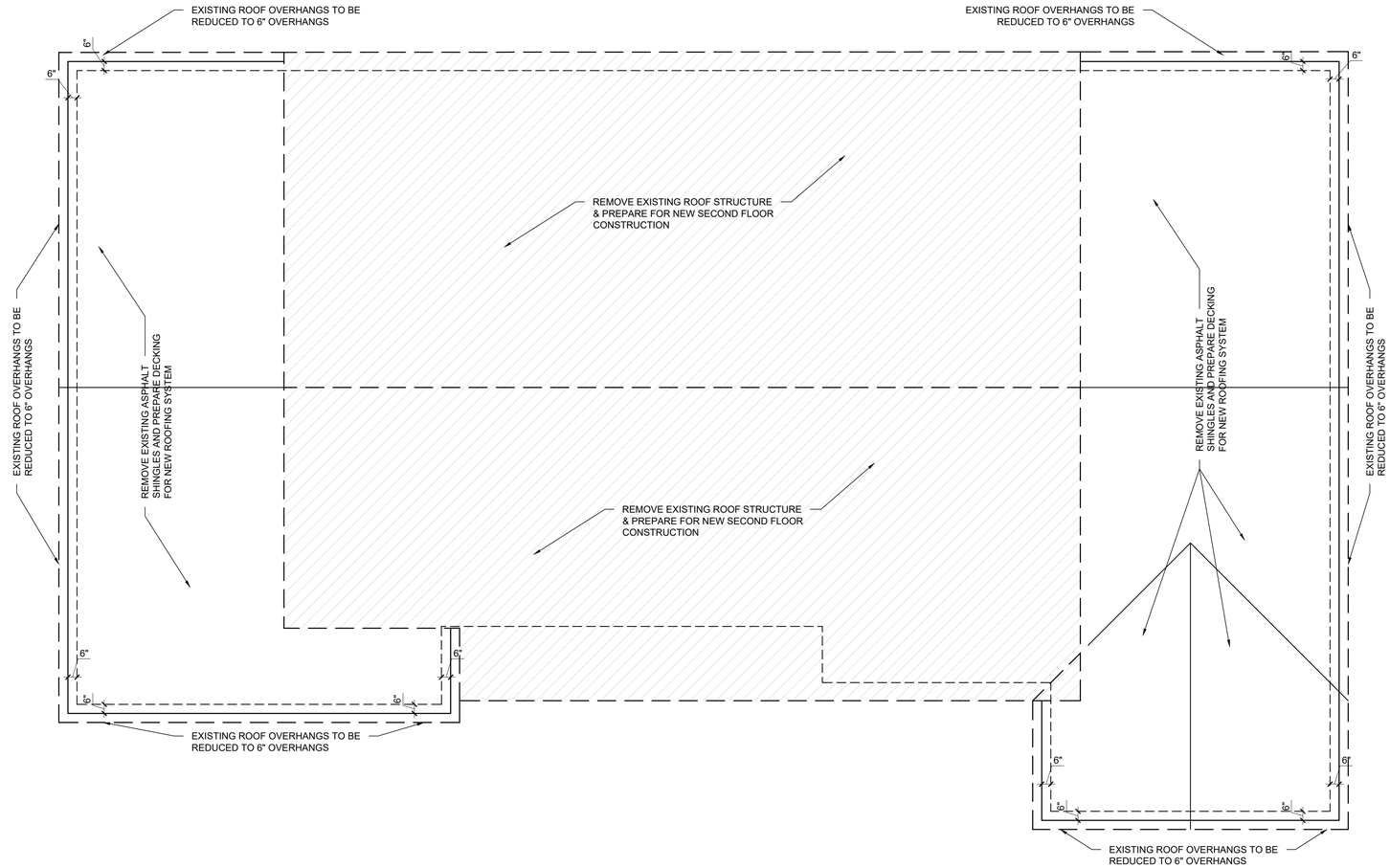
PREPARE EXISTING RESIDENCE FOR DEMOLITION AND NEW CONSTRUCTION. SUPPORT EXISTING STRUCTURE TO REMAIN AS REQUIRED PRIOR TO DEMOLITION.

THE CONTRACTOR IS TO CAP AND PROTECT ALL UTILITIES AS REQUIRED TO MEET CODE REQUIREMENTS.

REMOVE EXISTING EQUIPMENT, FIXTURES, WIRING, AND PIPING NOT BEING REUSED.

PLAN LEGEND

EXISTING ROOF STRUCTURE TO BE REMOVED



DEMOLITION ROOF PLAN

1

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

Revisions By

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06/19/2025
REGISTERED ARCHITECT
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26018
STATE OF TEXAS

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Contractor:
Captex Construction

ROOF DEMOLITION PLAN

drawn by: MJS
checked by: NS
scale: 1/4" = 1'-0"
first issue: 06/19/2025
plot date: 06/19/2025

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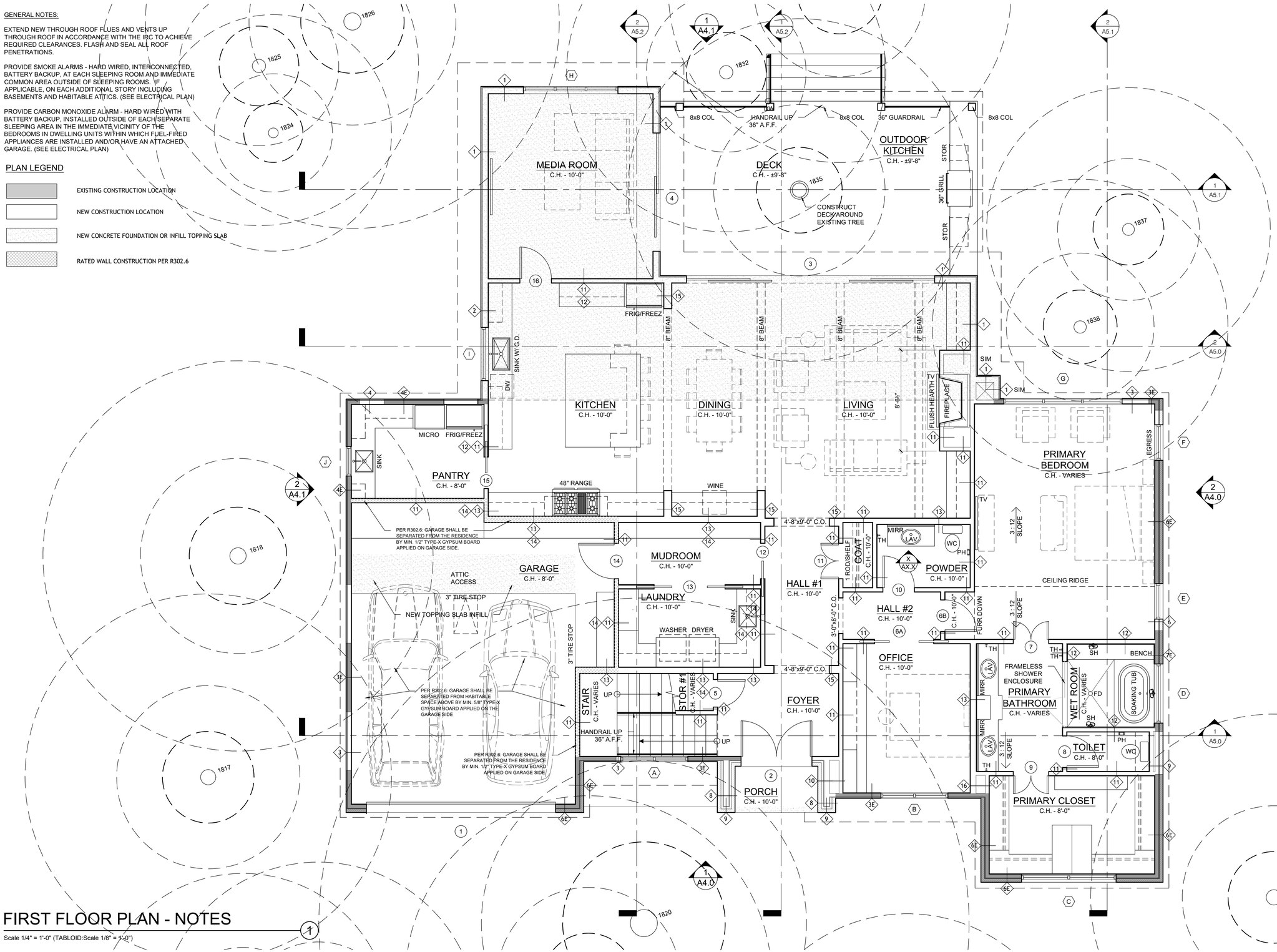
PROVIDE SMOKE ALARMS - HARD WIRED, INTERCONNECTED, BATTERY BACKUP, AT EACH SLEEPING ROOM AND IMMEDIATE COMMON AREA OUTSIDE OF SLEEPING ROOMS. IF APPLICABLE, ON EACH ADDITIONAL STORY INCLUDING BASEMENTS AND HABITABLE ATTICS. (SEE ELECTRICAL PLAN)

PROVIDE CARBON MONOXIDE ALARM - HARD WIRED WITH BATTERY BACKUP, INSTALLED OUTSIDE OF EACH SEPARATE SLEEPING AREA IN THE IMMEDIATE VICINITY OF THE BEDROOMS IN DWELLING UNITS WITHIN WHICH FUEL-FIRED APPLIANCES ARE INSTALLED AND/OR HAVE AN ATTACHED GARAGE. (SEE ELECTRICAL PLAN)

PLAN LEGEND

- EXISTING CONSTRUCTION LOCATION
- NEW CONSTRUCTION LOCATION
- NEW CONCRETE FOUNDATION OR INFILL TOPPING SLAB
- RATED WALL CONSTRUCTION PER R302.6



FIRST FLOOR PLAN - NOTES

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

Revisions By

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1ST FLOOR PLAN - NOTES

drawn by: MJS
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plot date: 06/19/2025

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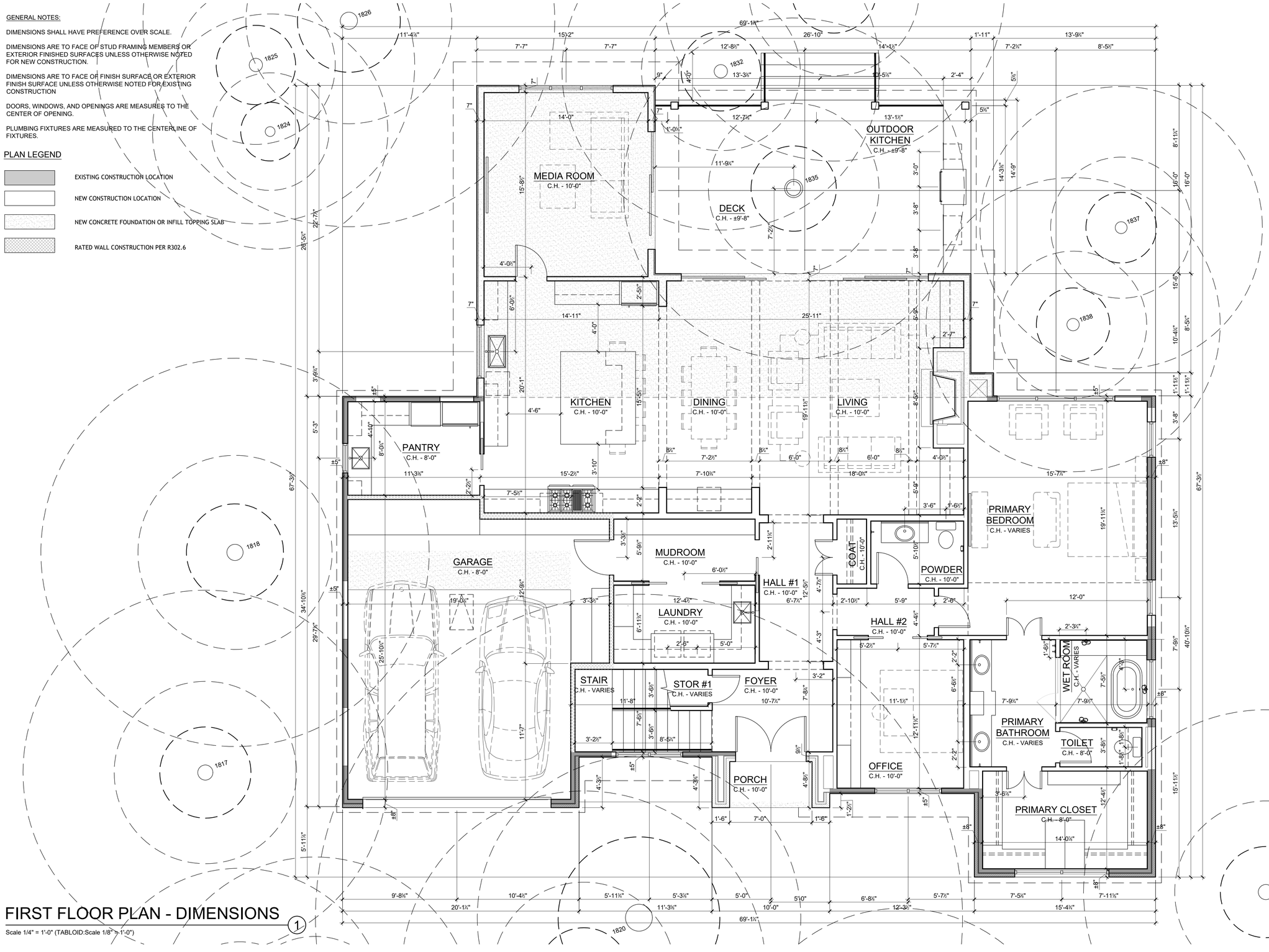
DOORS, WINDOWS, AND OPENINGS ARE MEASURES TO THE CENTER OF OPENING.

PLUMBING FIXTURES ARE MEASURED TO THE CENTERLINE OF FIXTURES.

PLAN LEGEND

- EXISTING CONSTRUCTION LOCATION
- NEW CONSTRUCTION LOCATION
- NEW CONCRETE FOUNDATION OR INFILL TOPPING SLAB
- RATED WALL CONSTRUCTION PER R302.6



FIRST FLOOR PLAN - DIMENSIONS

1

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

Revisions By

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1ST FLOOR PLAN - DIMENSIONS

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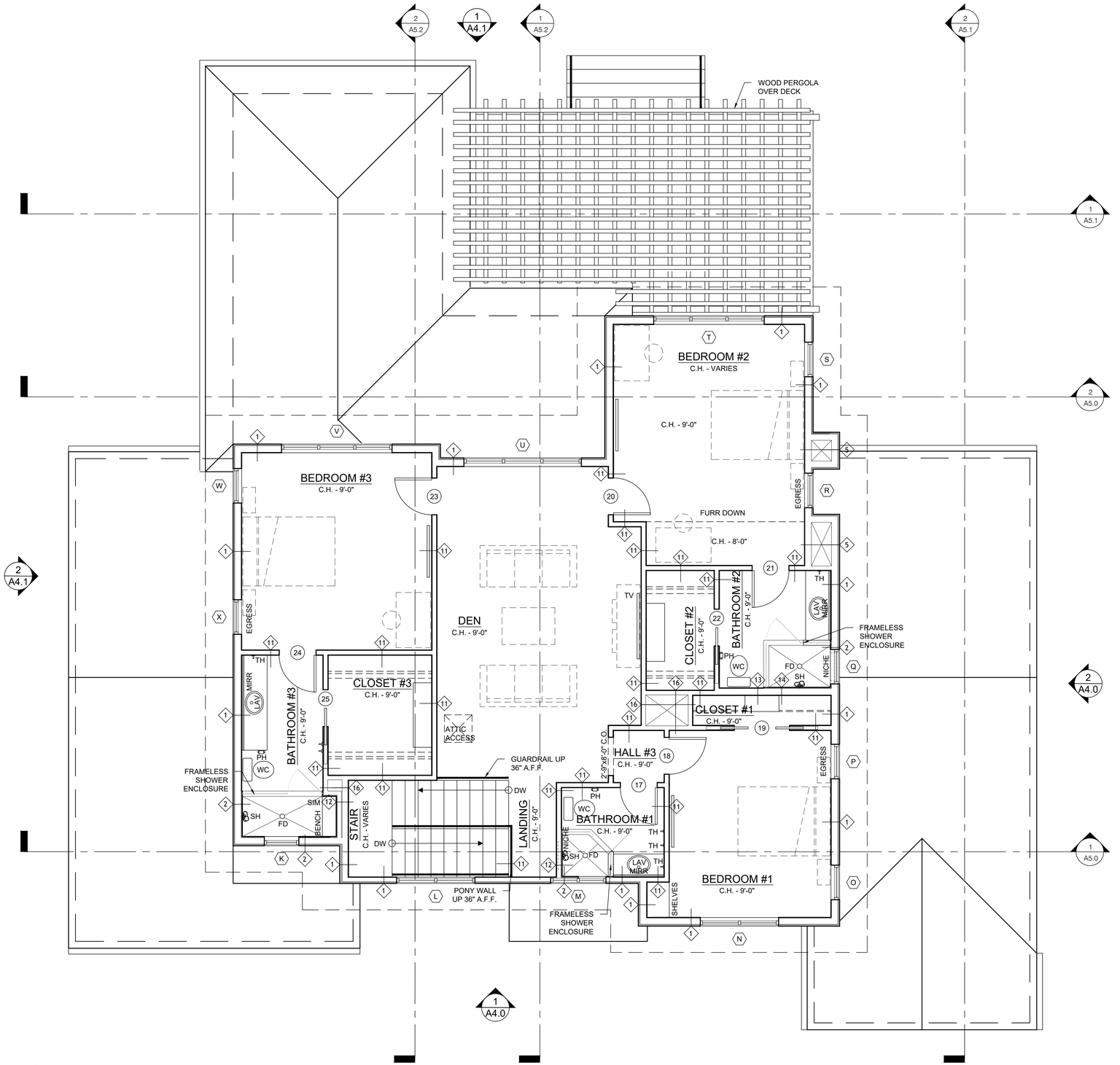
PLAN LEGEND

NEW CONSTRUCTION LOCATION



SECOND FLOOR PLAN - NOTES

1

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2ND FLOOR PLAN - NOTES

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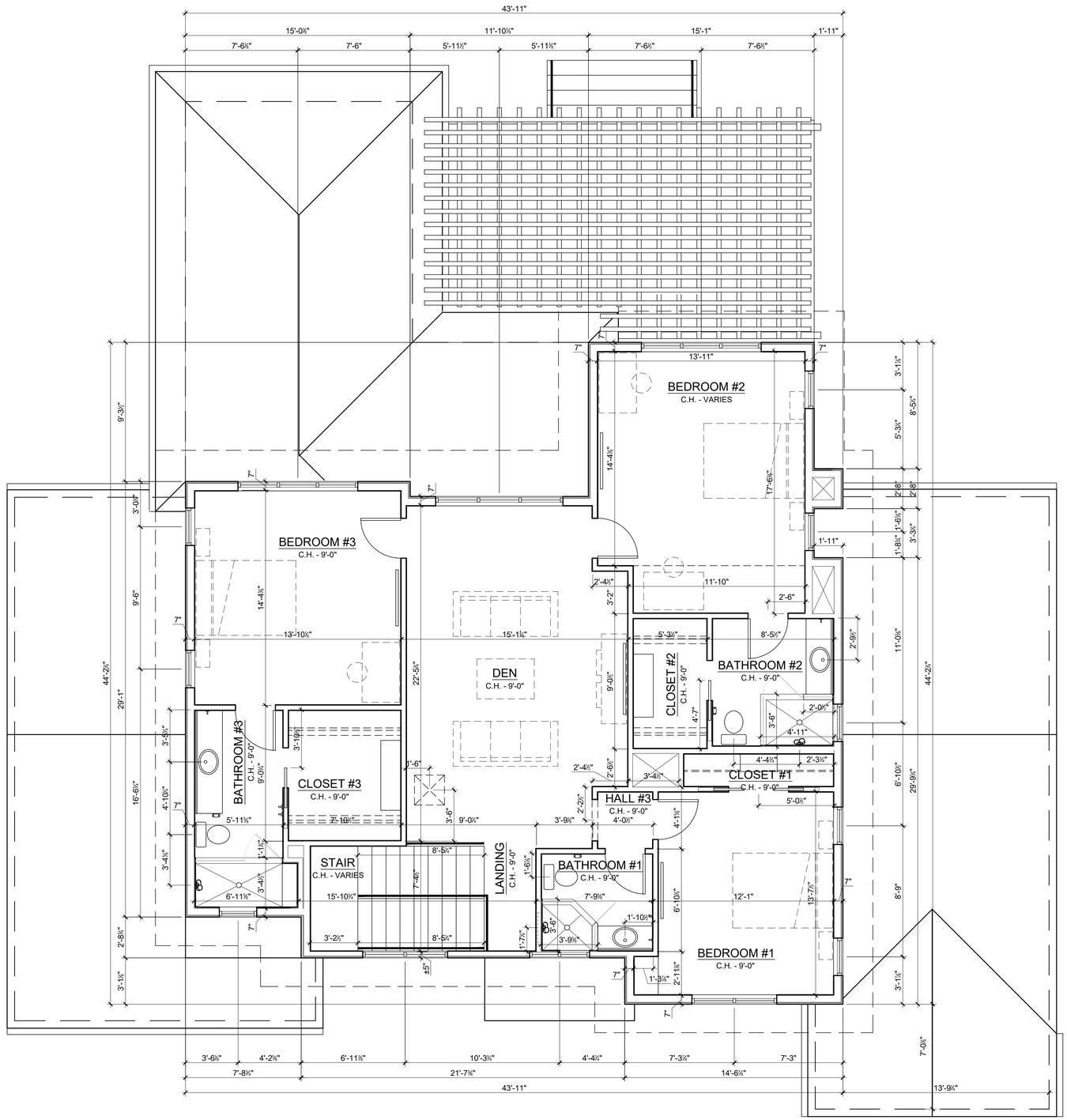
PLAN LEGEND

NEW CONSTRUCTION LOCATION



SECOND FLOOR PLAN - DIMENSIONS

1

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

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2ND FLOOR PLAN - DIMSNSIONS

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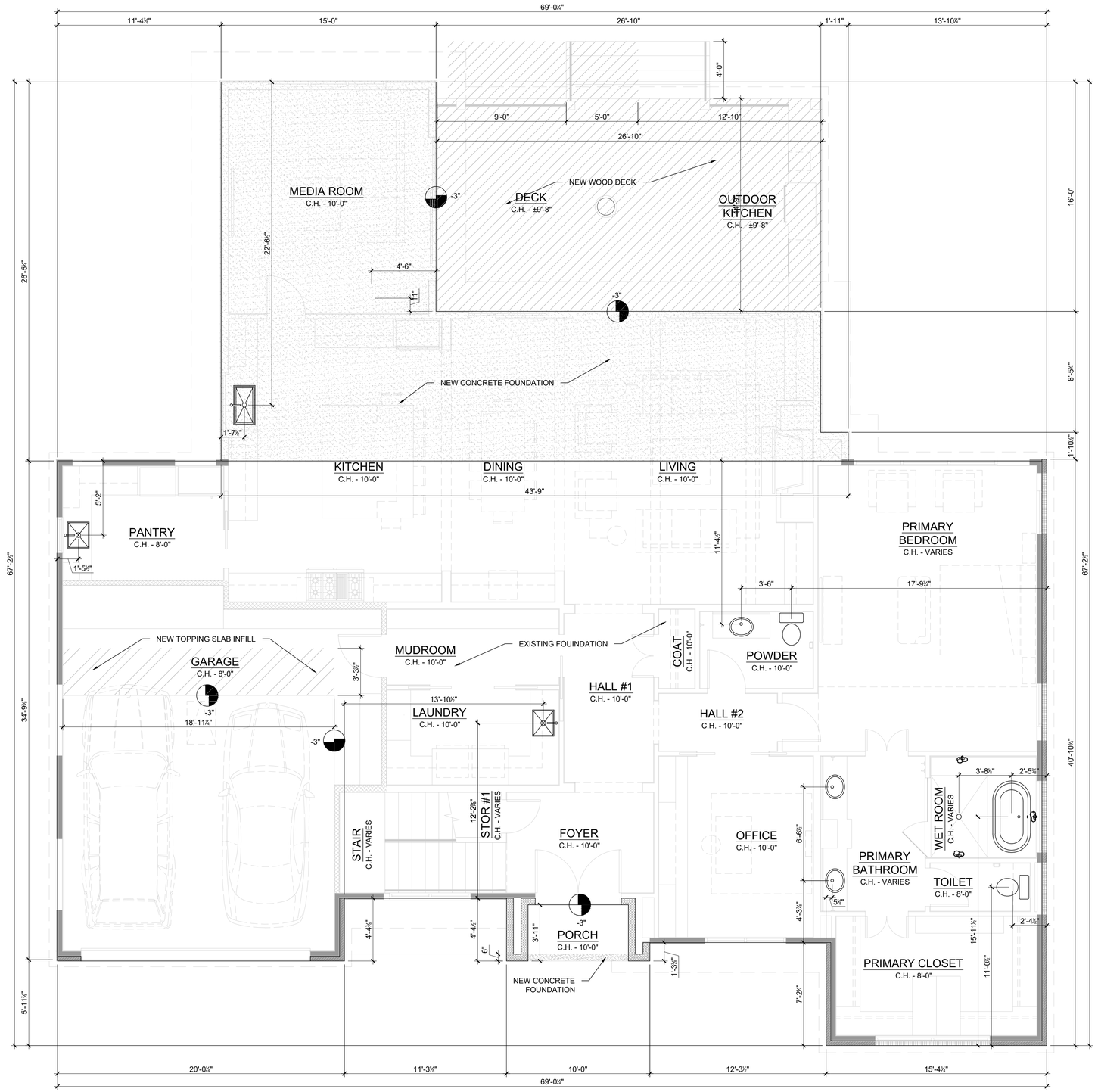
GENERAL NOTES:

DIMENSIONS ARE FROM EDGE OF SLAB TO CENTER OF FIXTURE.

ALL PENETRATIONS SHALL FALL WITHIN WALLS, INSIDE CHASES, OR AT FIXTURE. FIELD VERIFY SLAB PENETRATIONS.

LEGEND:

- NEW MASONRY LUG
- EXISTING MASONRY LUG LOCATION
- NEW CONCRETE FOUNDATION
- NEW TOPPING SLAB
- NEW WOOD DECK



EDGE OF SLAB PLAN

1

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

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EDGE OF SLAB PLAN

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GENERAL ROOF NOTES:

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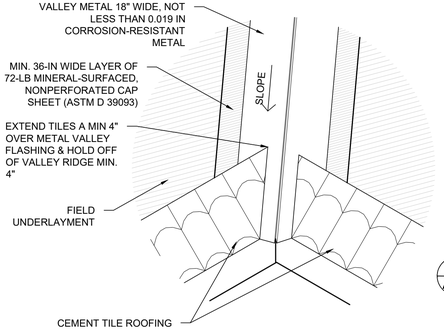
ALL VENTILATION OPENINGS, INCLUDING BUT NOT LIMITED TO ATTIC VENTS, UNDERFLOOR VENTS OR ANY VENT IN THE EXTERIOR WALLS, SHALL BE COVERED WITH NON-COMBUSTIBLE CORROSION RISISTANT MESH W/ OPENINGS THAT ARE ⅛" (3.3 MM) OR LESS OR MUST BEE DESIGNED AND APPROVED TO PREVENT FLAME OR EMBER PENETRATION INTO THE STRUCTURE. (EXCLUDING DRYER VENTS AND PLUMBING STACKS)

GUTTERS & DOWNSPOUTS WILL BE CONSTRUCTED OF NONCOMBUSTIBLE METAL MATERIAL AND PROVIDED WITH NONCOMBUSTIBLE, CORROSION RESISTANT METAL GUARDS AS A MEANS TO PREVENT THE ACCUMULATION OF LEAVES AND DEBRIS

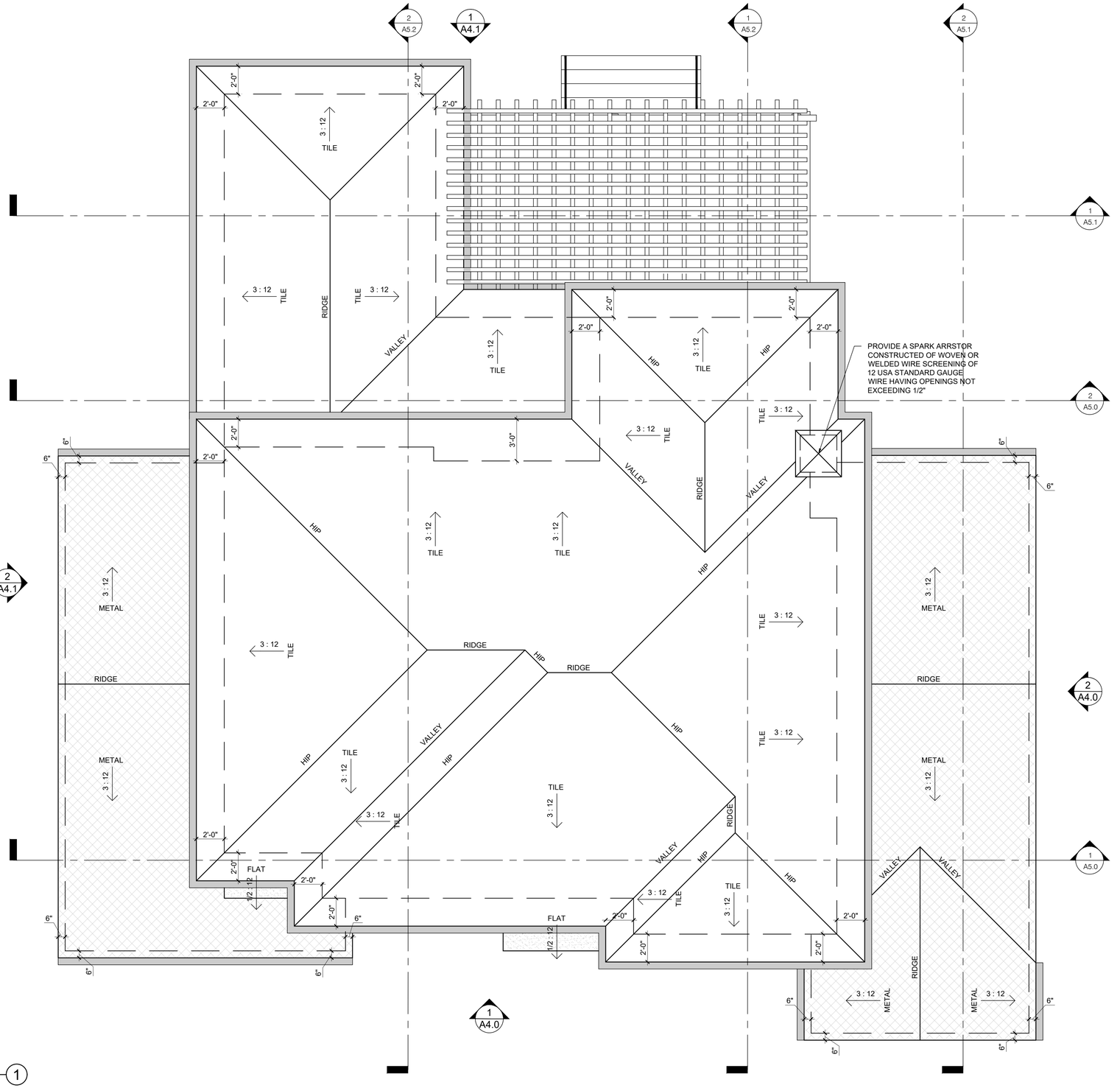
VALLEYS SHALL BE FLASHED ACCORDING DETAIL BELOW.

ROOF LEGEND

- NEW CEMENT ROOF TILES
- NEW LOW SLOPE STANDING SEAM ROOF
- NEW FLAT SINGLE PLY ROOF
- NEW GUTTER LOCATIONS
- WALL OUTLINE



VALLEY FLASHING DETAIL (NTS)
1) CEMENT TILE SHOULD NOT BE FASTENED THROUGH METAL VALLEY FLASHING



ROOF PLAN

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

1

Revisions By

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06/19/2025
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ROOF PLAN

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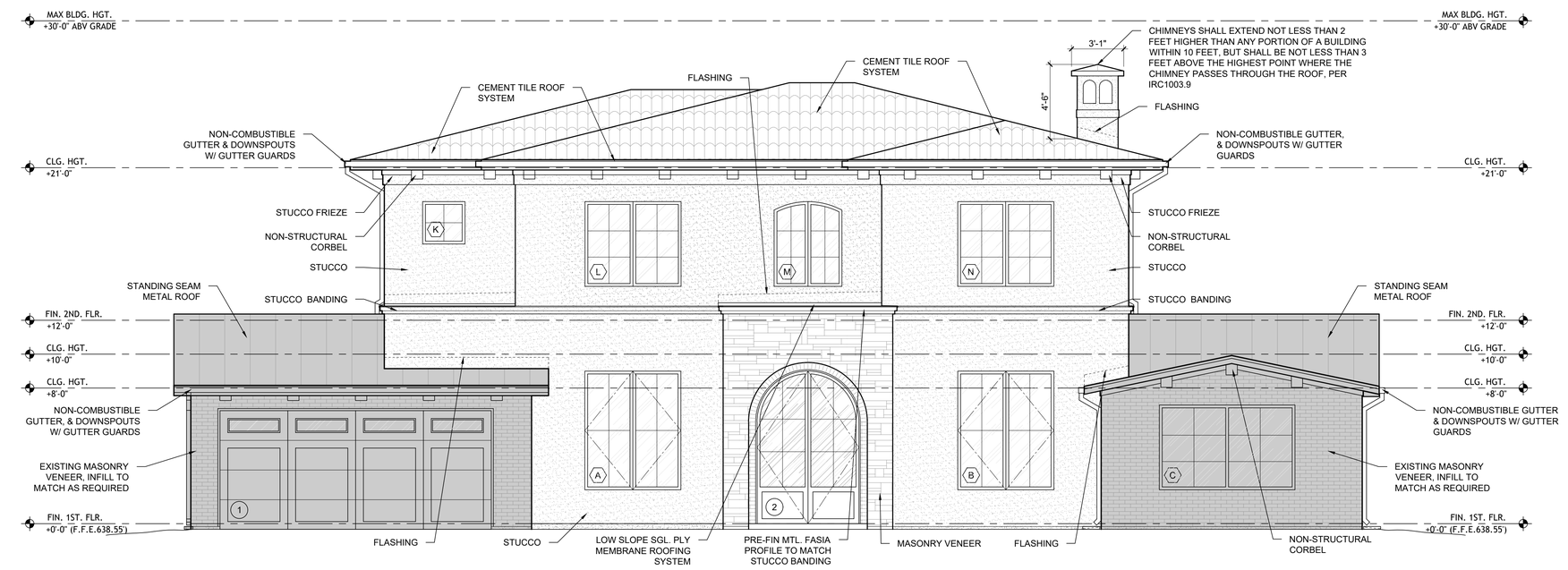
EXTERIOR ELEVATION LEGEND

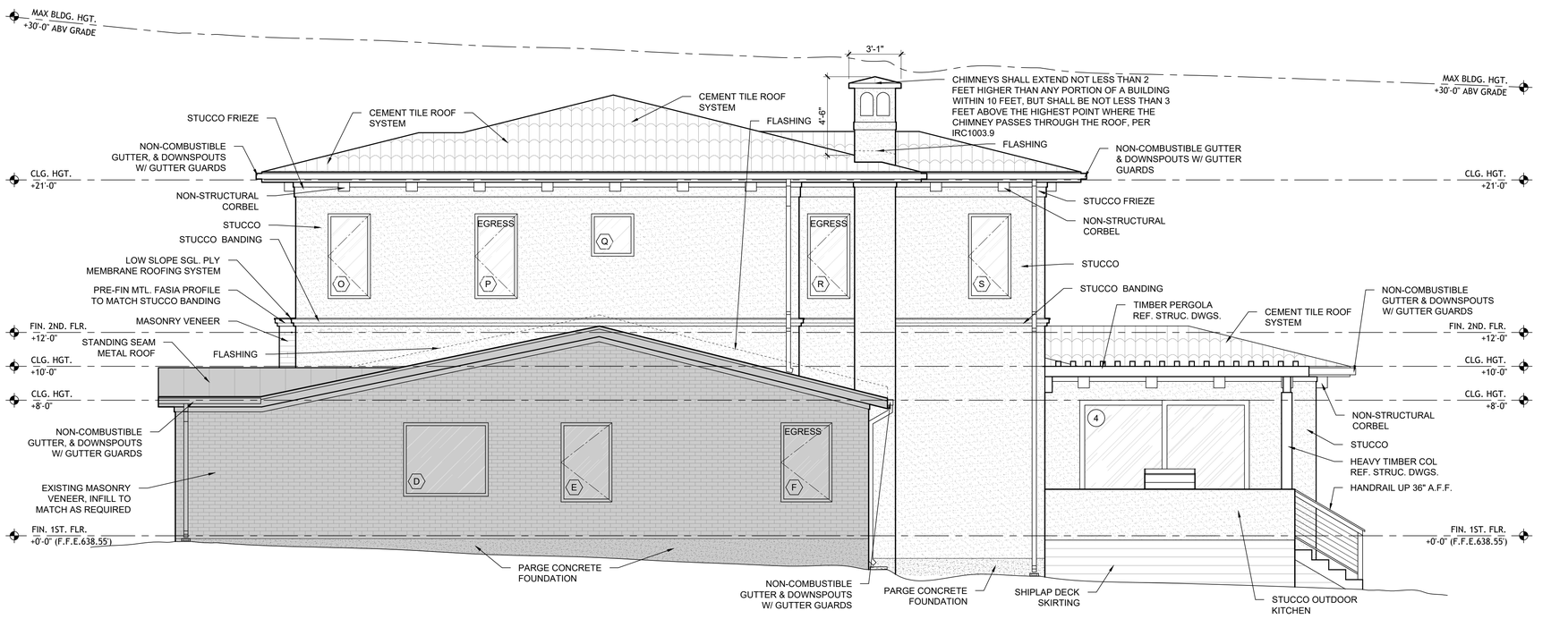
EXISTING CONSTRUCTION TO REMAIN, PROTECT AS REQUIRED, INFILL TO MATCH EXISTING



EXTERIOR ELEVATION

1

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")



EXTERIOR ELEVATION

2

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

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EXTERIOR ELEVATIONS

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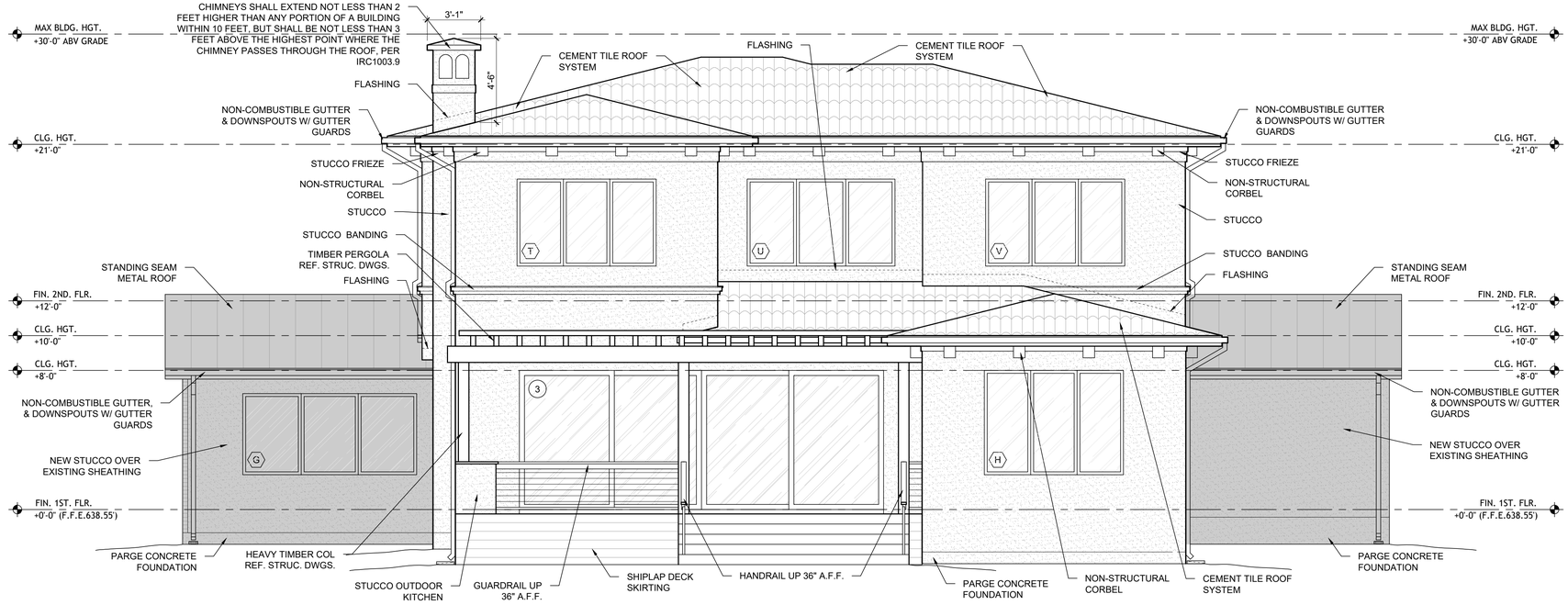
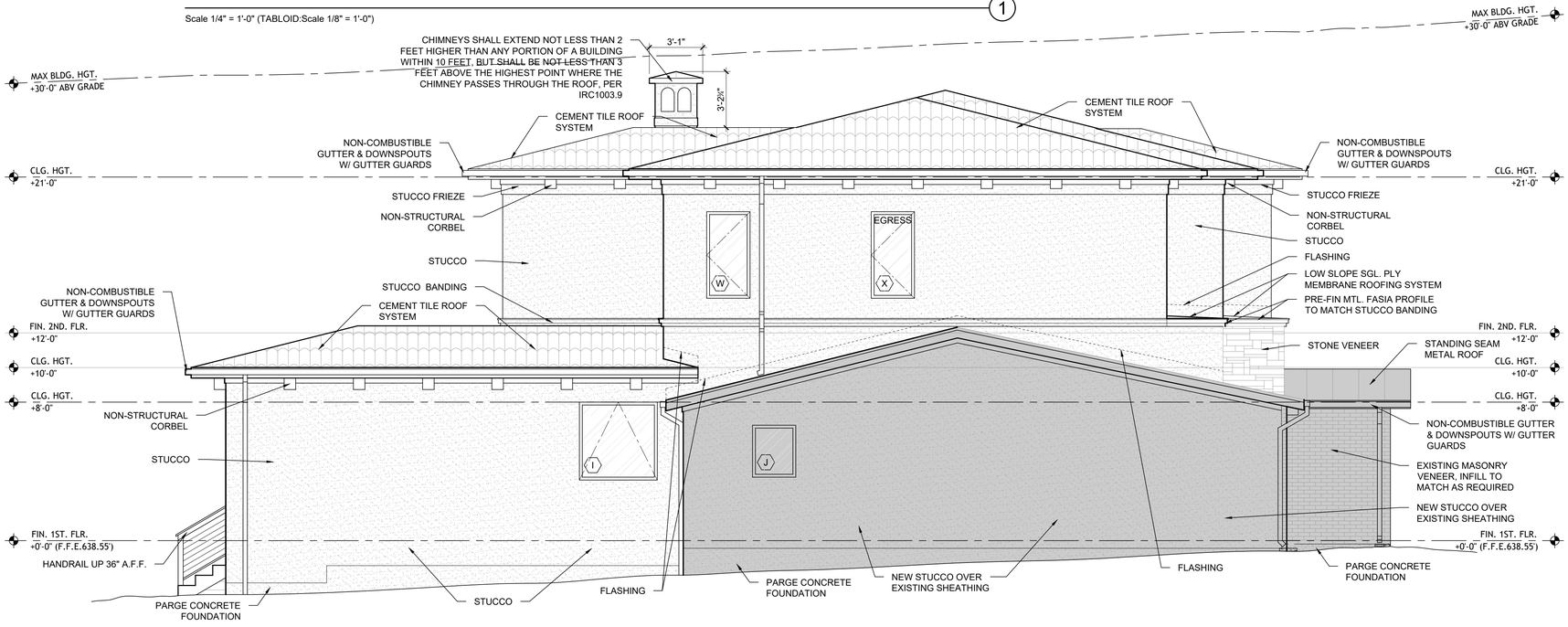
EXTERIOR ELEVATION LEGEND

EXISTING CONSTRUCTION TO REMAIN, PROTECT AS REQUIRED, INFILL TO MATCH EXISTING



EXTERIOR ELEVATION 1

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")



EXTERIOR ELEVATION 2

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

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EXTERIOR ELEVATIONS

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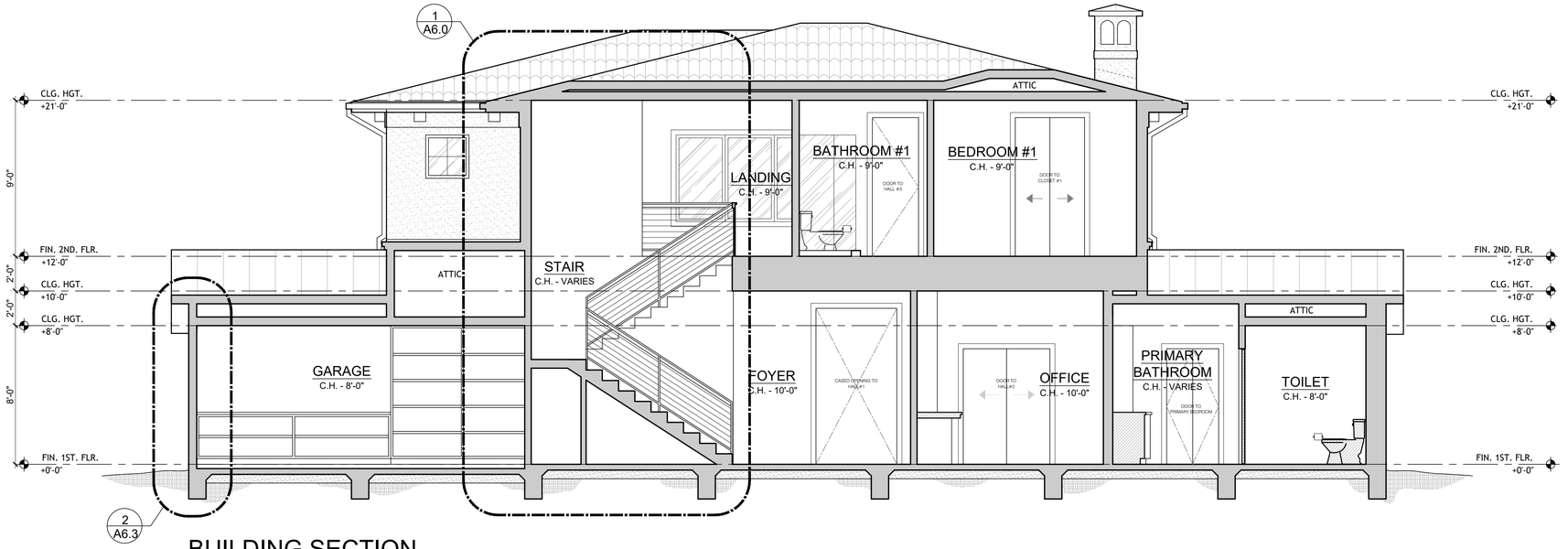
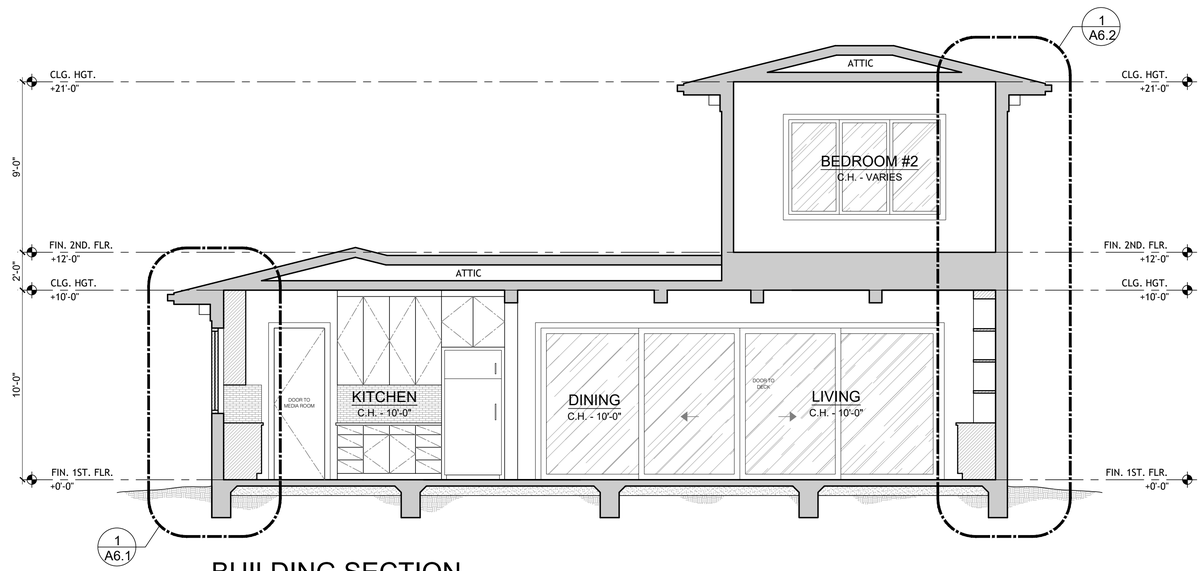


BUILDING SECTION

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

1



BUILDING SECTION

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2

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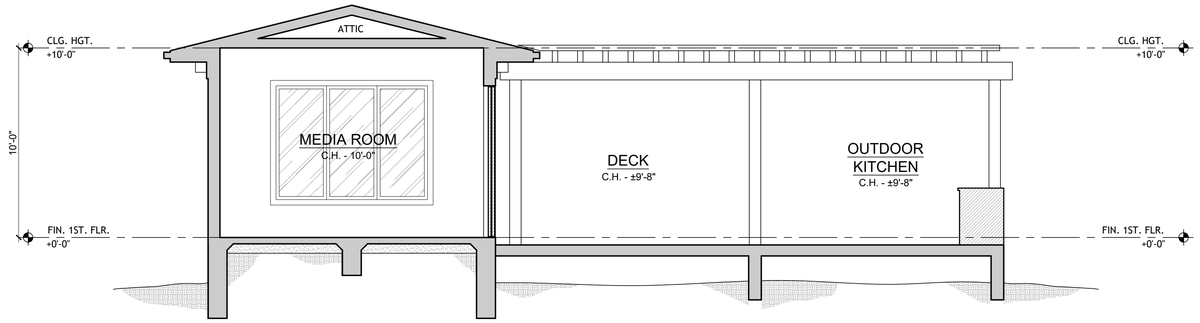

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1

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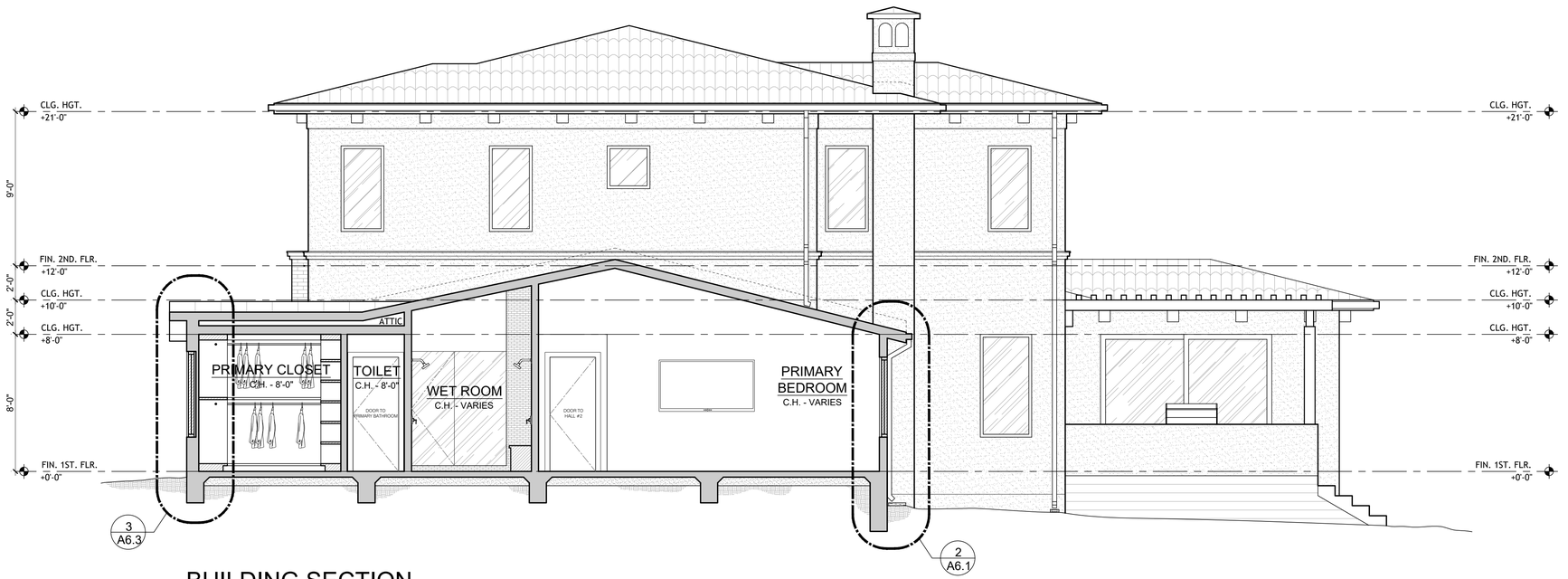

BUILDING SECTION

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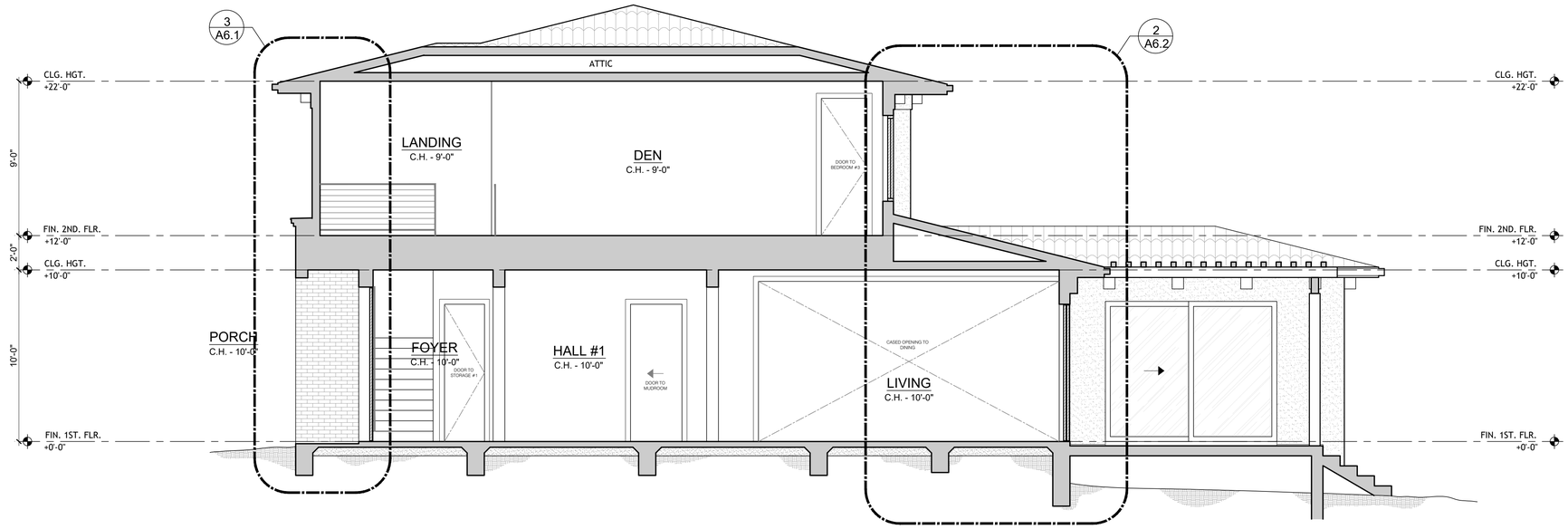
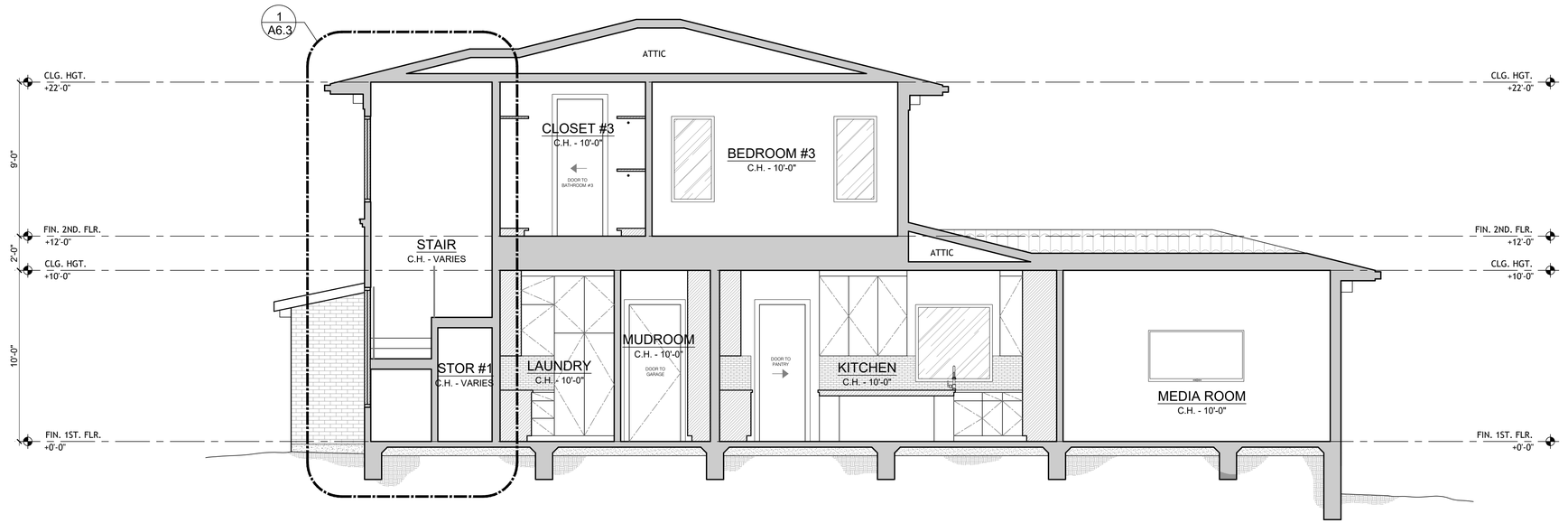


BUILDING SECTION

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

1



BUILDING SECTION

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

2

Revisions By

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06/19/2025
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STATE OF TEXAS

Project Owner:
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Project Address:
419 Ridgewood Rd
West Lake Hills 78746

Contractor:
Captex Construction

BUILDING SECTIONS

drawn by: MJS
checked by: NS
scale: 1/4" = 1'-0"
first issue: 06/19/2025
plot date: 06/19/2025

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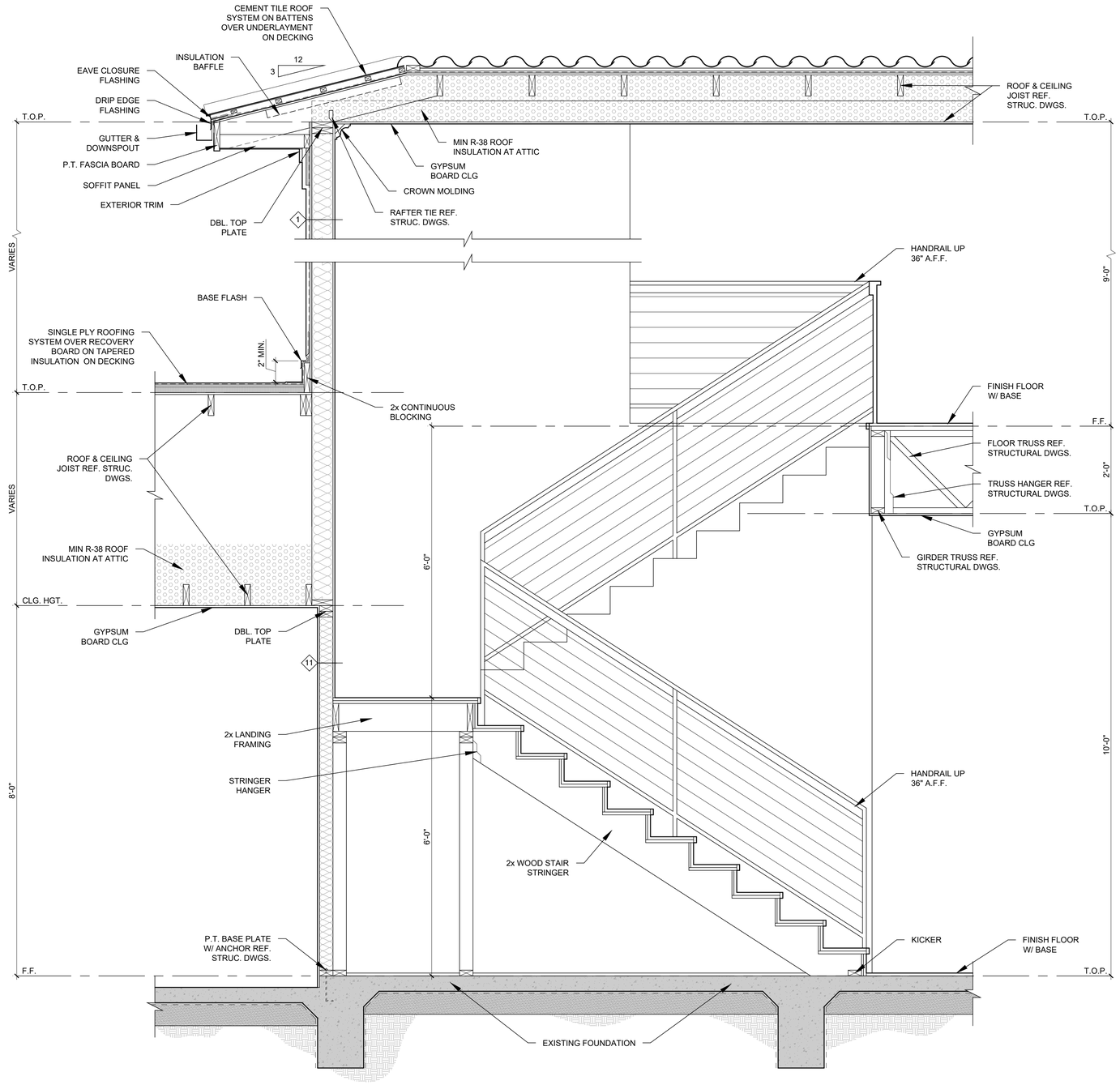
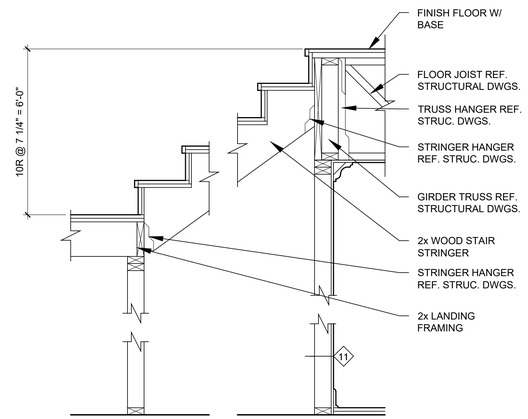


WALL SECTION 1

Scale 3/4" = 1'-0" (TABLOID:Scale 3/8" = 1'-0")



WALL SECTION 2

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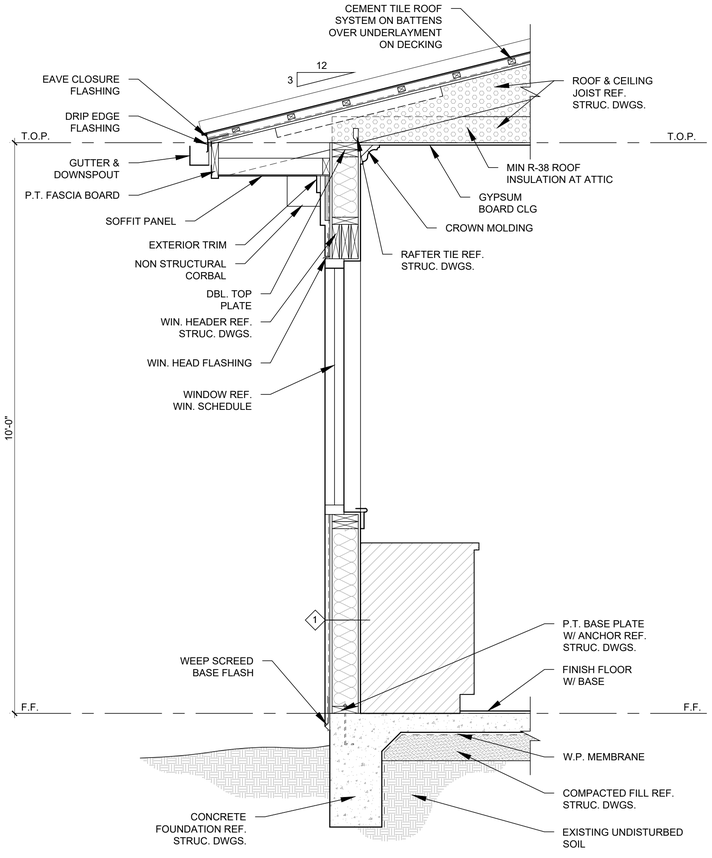

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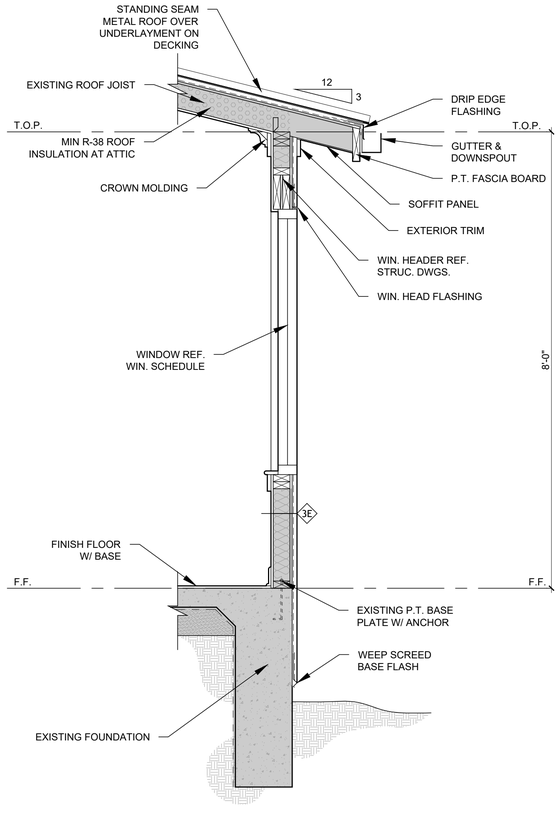

WALL SECTION 2

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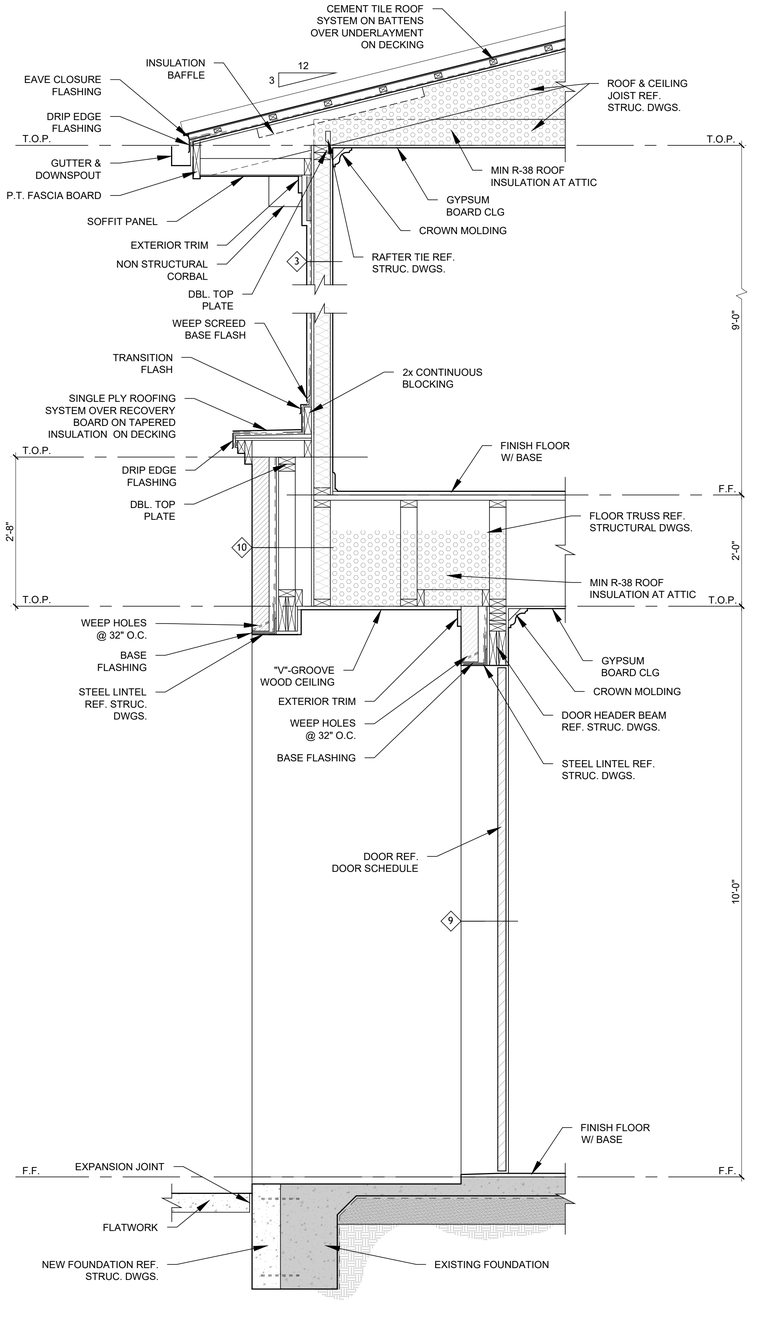

WALL SECTION 3

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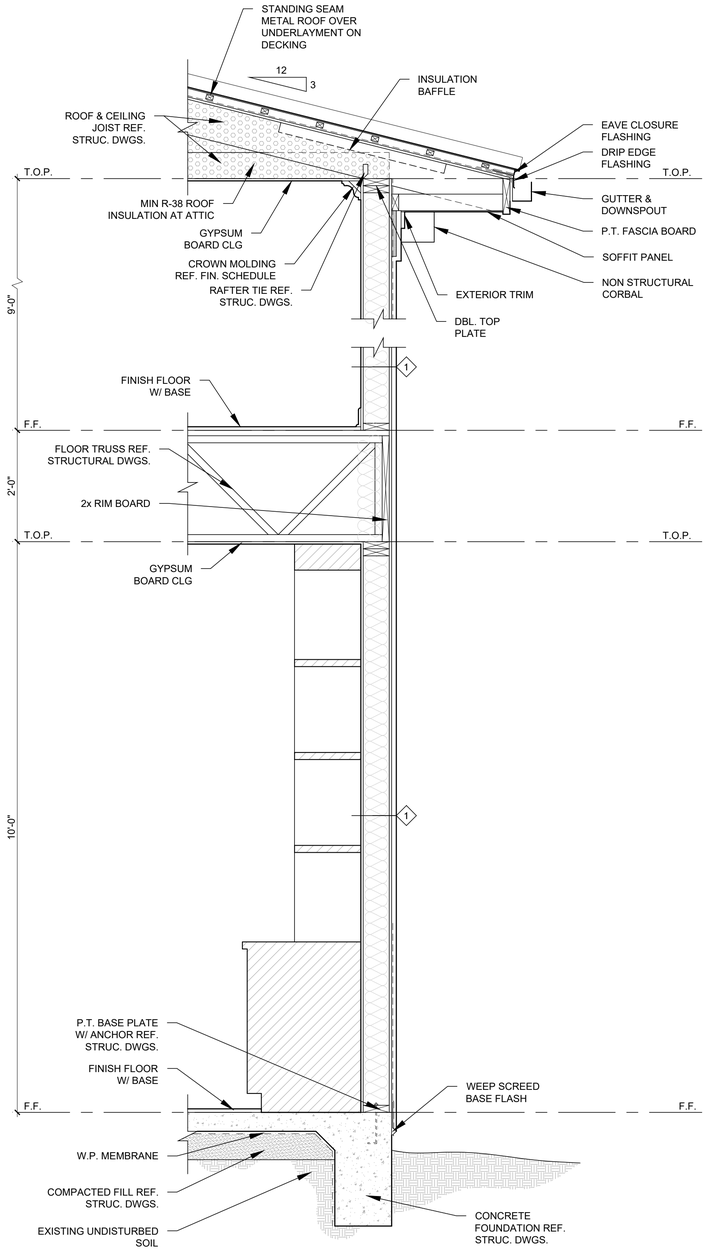

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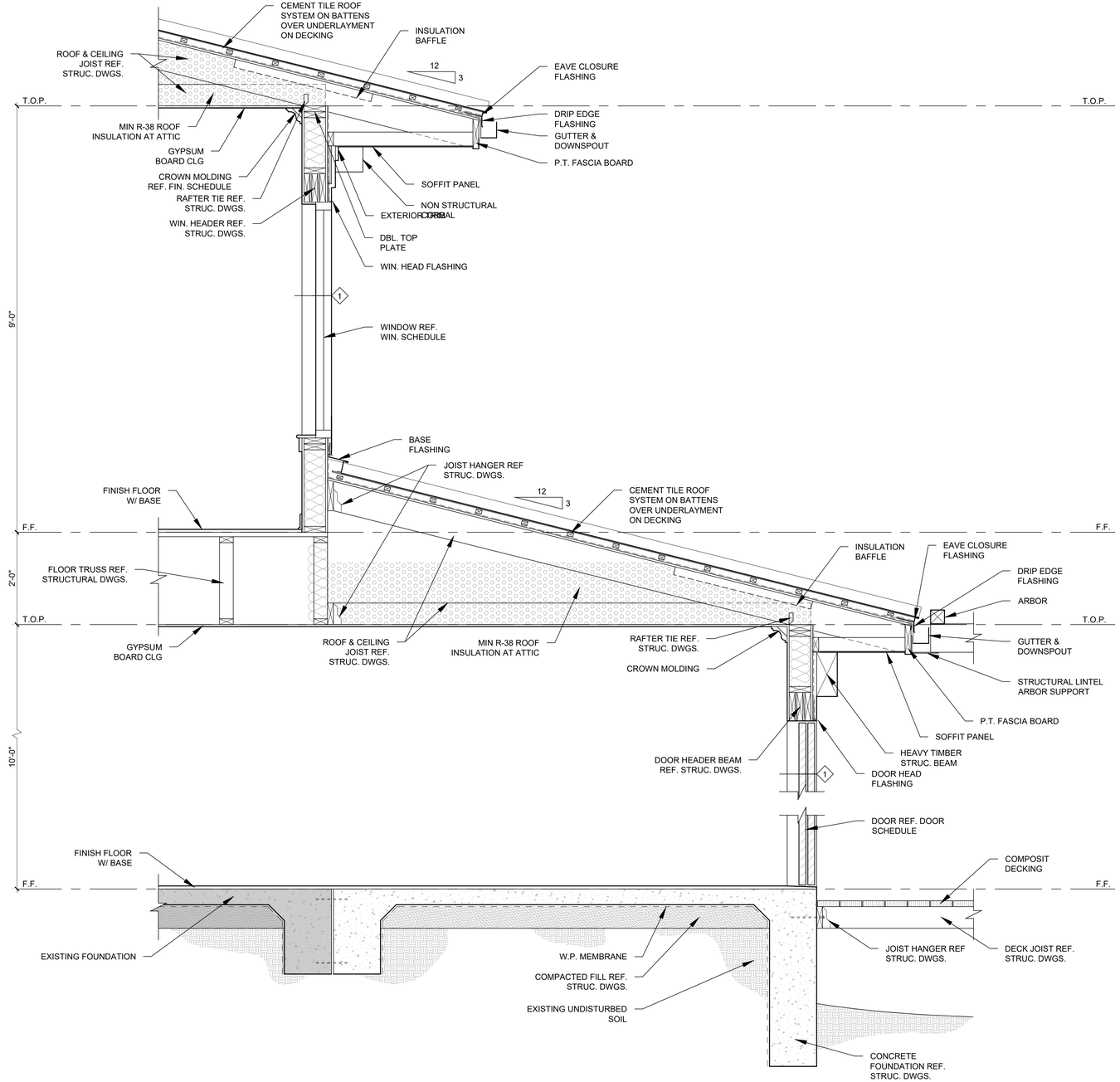

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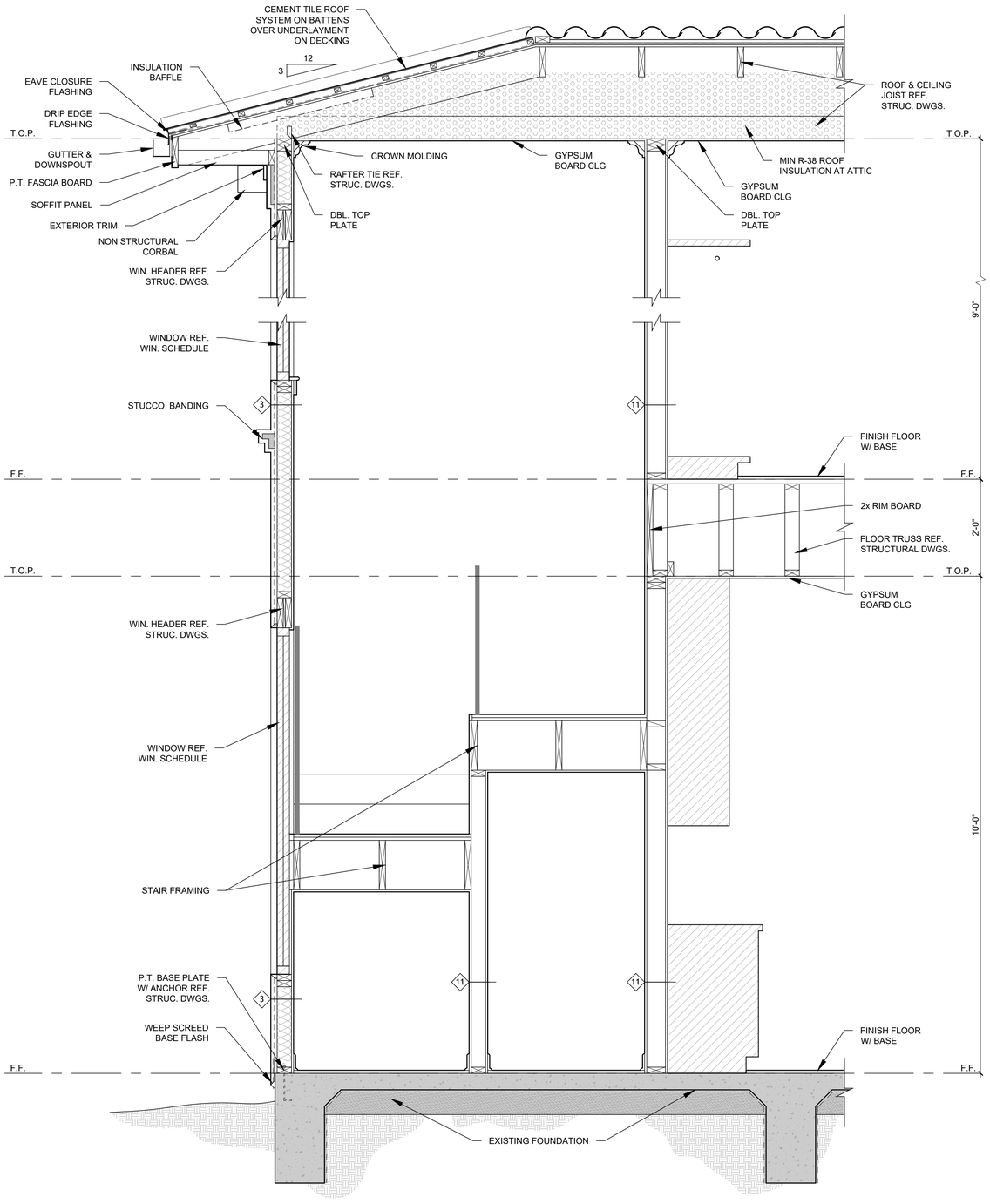

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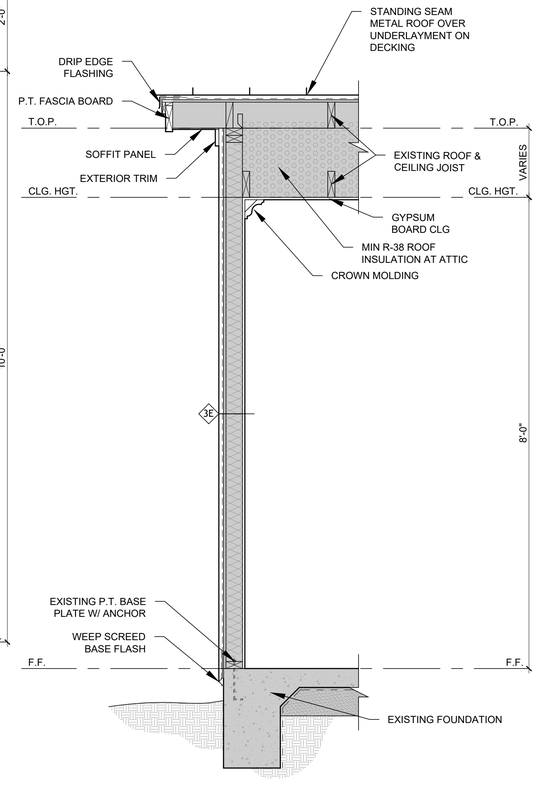

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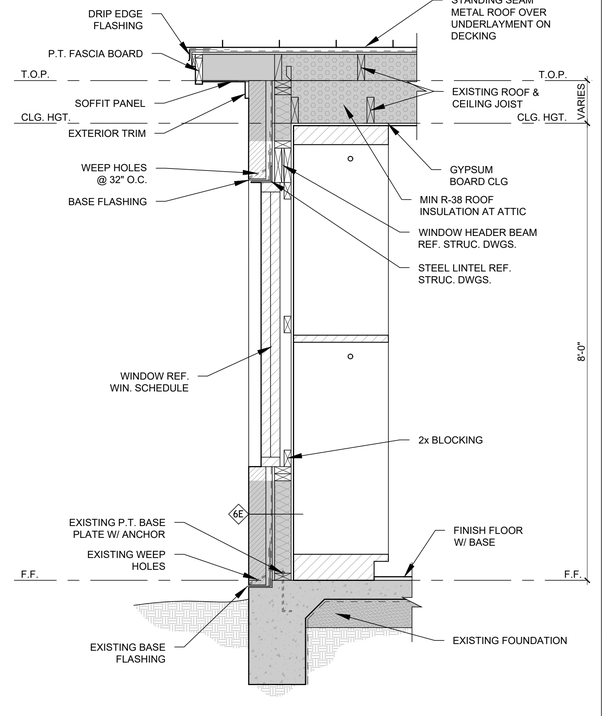

WALL SECTION 3

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- WATER ACCESS VALVE
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- HALF-HOT DUPLEX WALL OUTLET
- HALF-HOT DUPLEX FLOOR /COUNTER OUTLET
- DUPLEX FLOOR OUTLET
- "CBUS" OUTLET DEFINED AS CABLE, GIGABIT ETHERNET, TELEPHONE
- TELEPHONE OR DATA FLOOR OUTLET, USE CAT6 CABLE
- WALL SWITCH
- WALL DIMMER SWITCH
- THREE-WAY SWITCH
- FOUR-WAY SWITCH
- DOOR SWITCH
- OCCUPANCY SWITCH
- PUSH BUTTON SWITCH
- TIMER SWITCH
- SMOKE AND CARBON MONOXIDE DETECTOR/ALARM
- NOTE: SMOKE DETECTORS SHALL RECEIVE THEIR PRIMARY
- POWER SOURCE FROM THE BUILDING WIRING, SHALL BE
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- BACK-UP AND LOW BATTERY SIGNAL.
- WALL-MOUNTED LIGHT FIXTURE
- CEILING-MOUNTED LIGHT FIXTURE
- CEILING-MOUNTED PENDANT LIGHT FIXTURE
- HEAVY CEILING-MOUNTED PENDANT LIGHT FIXTURE (BLOCKING REQ'D)
- 4" (UNO) RECESSED CAN LIGHT FIXTURE (MUST SUPPORT LED LIGHTS)
- 4" RECESSED CAN LIGHT FIXTURE - WET LOCATION (MUST SUPPORT LED LIGHTS)
- DIRECTION DOWN LIGHT FIXTURE (MUST SUPPORT LED LIGHTS)
- WALL MOUNTED HIGH EFFICIENCY LUMINAIRE SCONCE
- WALL MOUNTED HIGH EFFICIENCY LUMINAIRE SCONCE W/ MOTION SENSOR
- WALL MOUNTED GAS LUMINAIRE
- LED STRIP LIGHT/ OVER-UNDER CABINET LIGHT
- 1x4 / 2x4 LED LIGHT
- SECURITY FLOOD LIGHT
- RECESSED VENT FAN CAPABLE OF PROVIDING 5 AIR CHANGES/HR
- POWERED EXHAUST HOOD
- GARBAGE DISPOSAL
- THROUGH-WALL VENT FAN
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- THERMOSTAT
- VIDEO DOOR CHIME
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- RECESSED STAIR LIGHT
- CEILING FAN (BLOCKING REQ'D.)
- CEILING FAN/LIGHT COMBO (BLOCKING REQ'D.)
- FUSED DISCONNECT - SIZE PER MANU. REQ'D.
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- ELECTRIC PANEL
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ALL LIGHT FIXTURES LED OR HIGH EFFICACY U.N.O.

AT LEAST ONE 20 AMP BRANCH CIRCUIT SHALL BE PROVIDED TO SUPPLY BATHROOM RECEPTACLE OUTLETS. SUCH CIRCUITS SHALL HAVE NO OTHER OUTLETS.

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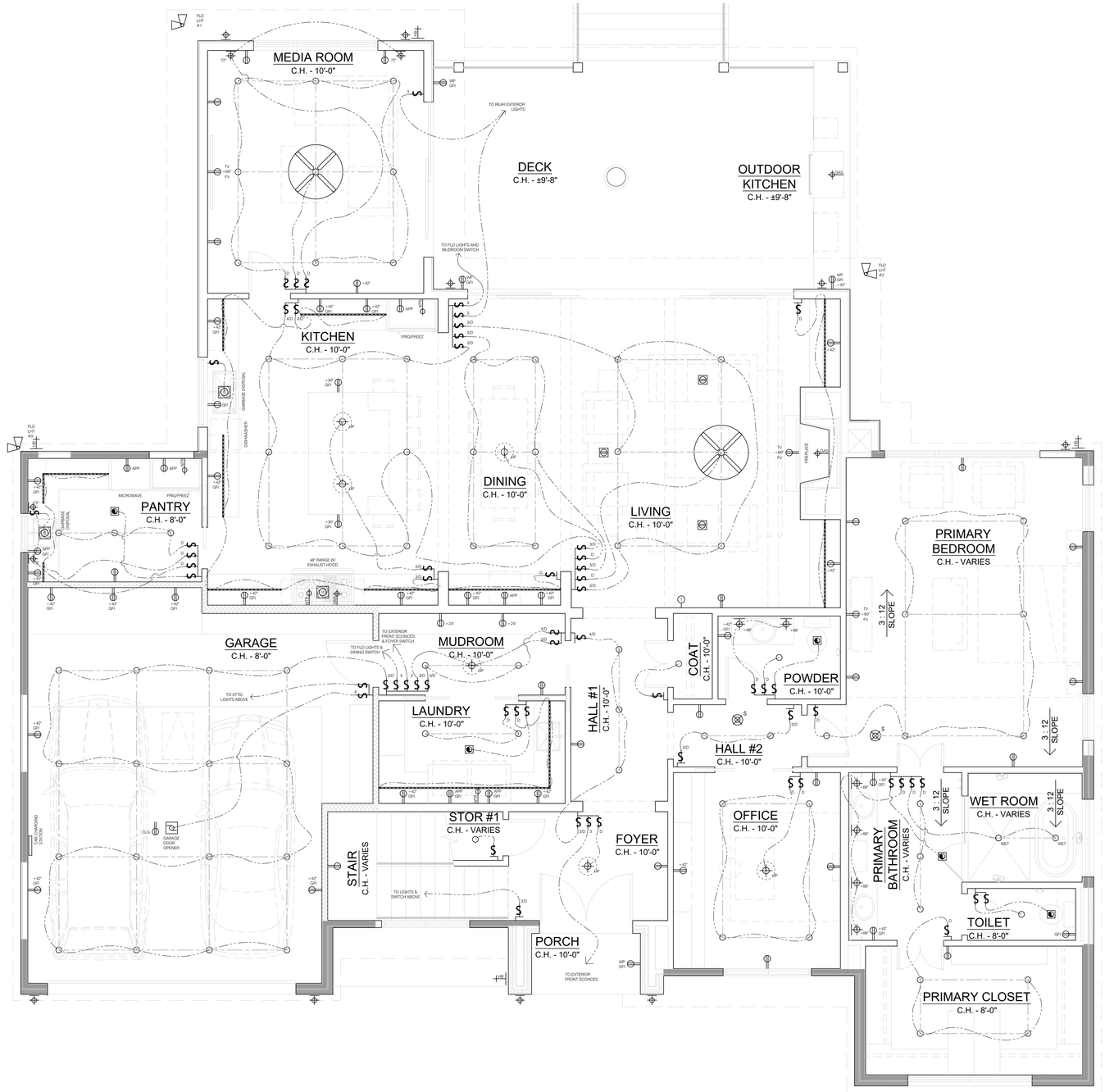

FIRST FLOOR ELECTRICAL PLAN

1

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

Revisions By

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06/19/2025
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Contractor:
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1ST FLOOR ELECTRICAL PLAN

drawn by: MJS
checked by: NS
scale: 1/4" = 1'-0"
first issue: 06/19/2025
plot date: 06/19/2025

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- 1x4 / 2x4 LED LIGHT
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- GARBAGE DISPOSAL
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ALL LIGHT FIXTURES LED OR HIGH EFFICACY U.N.O.

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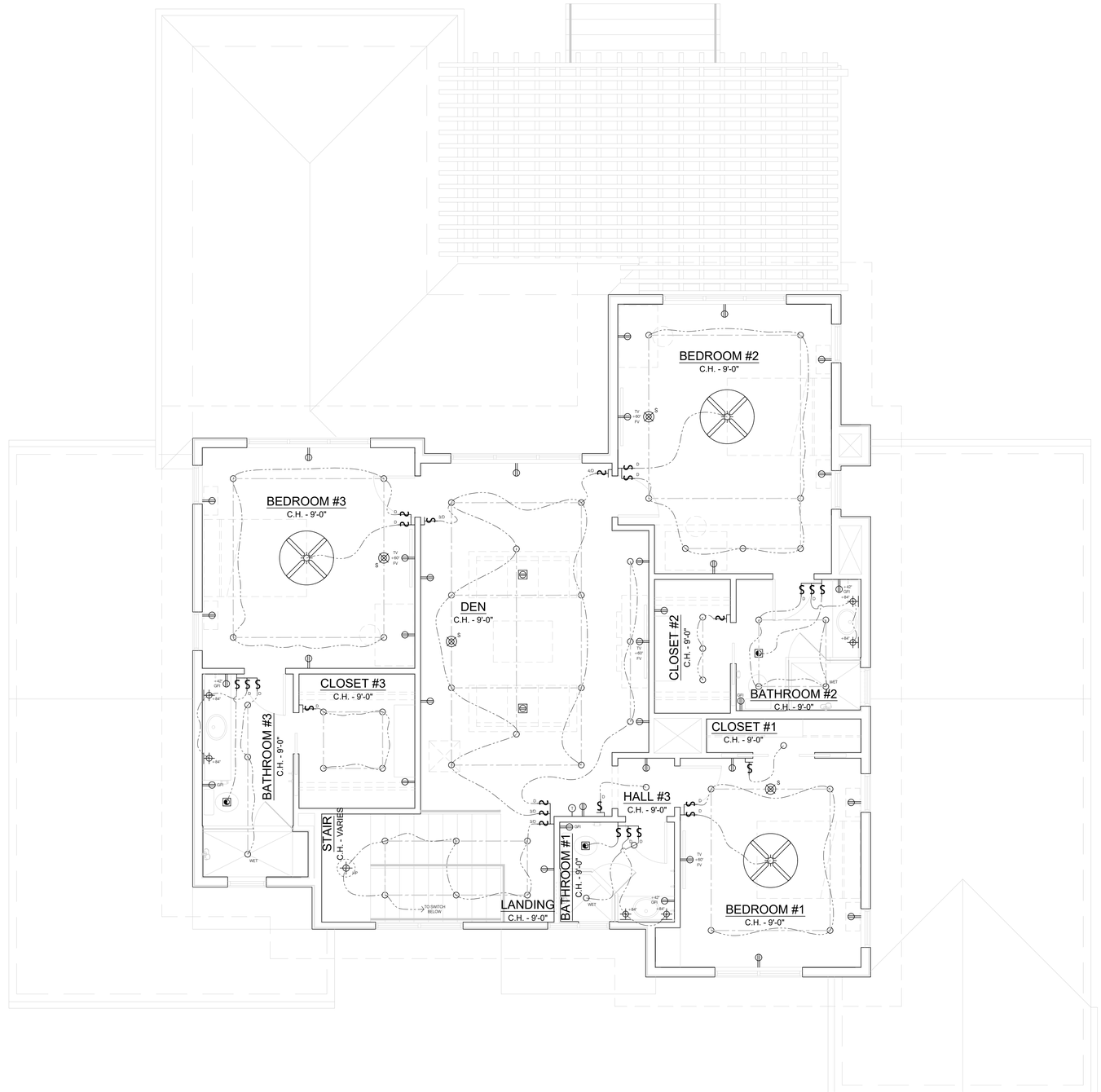

SECOND FLOOR ELECTRICAL PLAN

1

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Revisions By

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2ND FLOOR ELECTRICAL PLAN

drawn by: MJS
checked by: NS
scale: 1/4" = 1'-0"
first issue: 06/19/2025
plot date: 06/19/2025

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LEGEND

- WALL-MOUNTED LIGHT FIXTURE
- CEILING-MOUNTED LIGHT FIXTURE
- CEILING-MOUNTED PENDANT LIGHT FIXTURE
- HEAVY CEILING-MOUNTED PENDANT LIGHT FIXTURE (BLOCKING REQ'D.)
- 4" (UNO) RECESSED CAN LIGHT FIXTURE (MUST SUPPORT LED LIGHTS)
- 4" RECESSED CAN LIGHT FIXTURE - WET LOCATION (MUST SUPPORT LED LIGHTS)
- DIRECTION DOWN LIGHT FIXTURE (MUST SUPPORT LED LIGHTS)
- WALL MOUNTED HIGH EFFICIENCY LUMINAIRE SCONCE
- WALL MOUNTED HIGH EFFICIENCY LUMINAIRE SCONCE W/ MOTION SENSOR
- WALL MOUNTED GAS LUMINAIRE
- LED STRIP LIGHT/ OVER-UNDER CABINET LIGHT
- 1x4 / 2x4 LED LIGHT
- SECURITY FLOOD LIGHT
- CEILING FAN (BLOCKING REQ'D.)
- CEILING FAN/LIGHT COMBO (BLOCKING REQ'D.)
- RECESSED VENT FAN CAPABLE OF PROVIDING 5 AIR CHANGES/HR
- S SMOKE AND CARBON MONOXIDE DETECTOR/ALARM
- C NOTE: SMOKE DETECTORS SHALL RECEIVE THEIR PRIMARY
- SC POWER SOURCE FROM THE BUILDING WIRING, SHALL BE INTERCONNECTED AND SHALL BE EQUIPPED WITH BATTERY BACK-UP AND LOW BATTERY SIGNAL.

GENERAL NOTES:

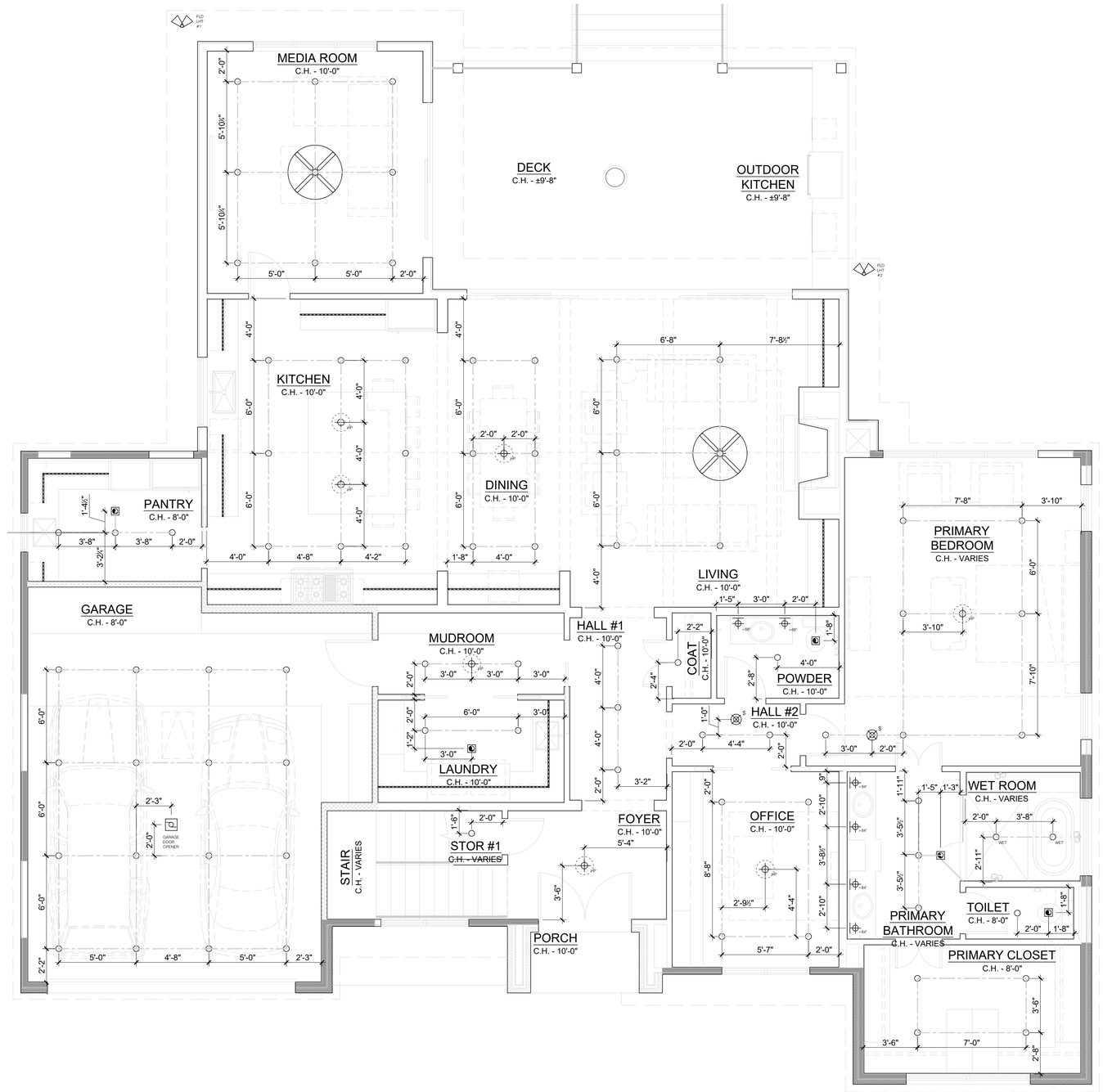
REFERENCE ELECTRICAL PLANS AND INTERIOR AND EXTERIOR ELEVATIONS FOR ADDITIONAL NOTE.

DIMENSIONS ARE TO CENTERLINE OF FIXTURE TO CENTERLINE OF FIXTURE AND FROM FACE OF STUD FRAMING MEMBER TO CENTERLINE OF FIXTURE ON NEW CONSTRUCTION, AND FACE OF FINISH SURFACE TO CENTERLINE OF FIXTURE ON EXISTING CONSTRUCTION . UNLESS OTHERWISE NOTED.

FIELD VERIFY WALL MOUNTED FIXTURE HEIGHT WITH FIXTURE SELECTION.

PROVIDE SOLID BLOCKING IN CEILING AT ALL CEILING FAN AND HEAVY PENDENT LIGHT LOCATIONS.

IF LIGHTING LAYOUT REQUIRES ALTERATION DUE TO CONFLICT OF GREATER THAN 12" NOTIFY ARCHITECT FOR NEW LIGHTING LAYOUT.



FIRST FLOOR REFLECTED CEILING PLAN

1

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

Revisions By

ARTERBERRY COOKE architecture

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Alice Arterberry
3411 Windsor Rd
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323.236.5182

06/19/2025 REGISTERED ARCHITECT ALICE ARTERBERRY 21601 STATE OF TEXAS

Project Owner:
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3806 Meandering Creek Cv
Austin TX 78746

Project Address:
419 Ridgewood Rd
West Lake Hills 78746

Contractor:
Captex Construction

1ST FLOOR REFLECTED CEILING PLAN

drawn by: MJS
checked by: NS
scale: 1/4" = 1'-0"
first issue: 06/19/2025
plot date: 06/19/2025

PERMIT SET

E2.0

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LEGEND

- WALL-MOUNTED LIGHT FIXTURE
- CEILING-MOUNTED LIGHT FIXTURE
- CEILING-MOUNTED PENDANT LIGHT FIXTURE
- HEAVY CEILING-MOUNTED PENDANT LIGHT FIXTURE (BLOCKING REQ'D.)
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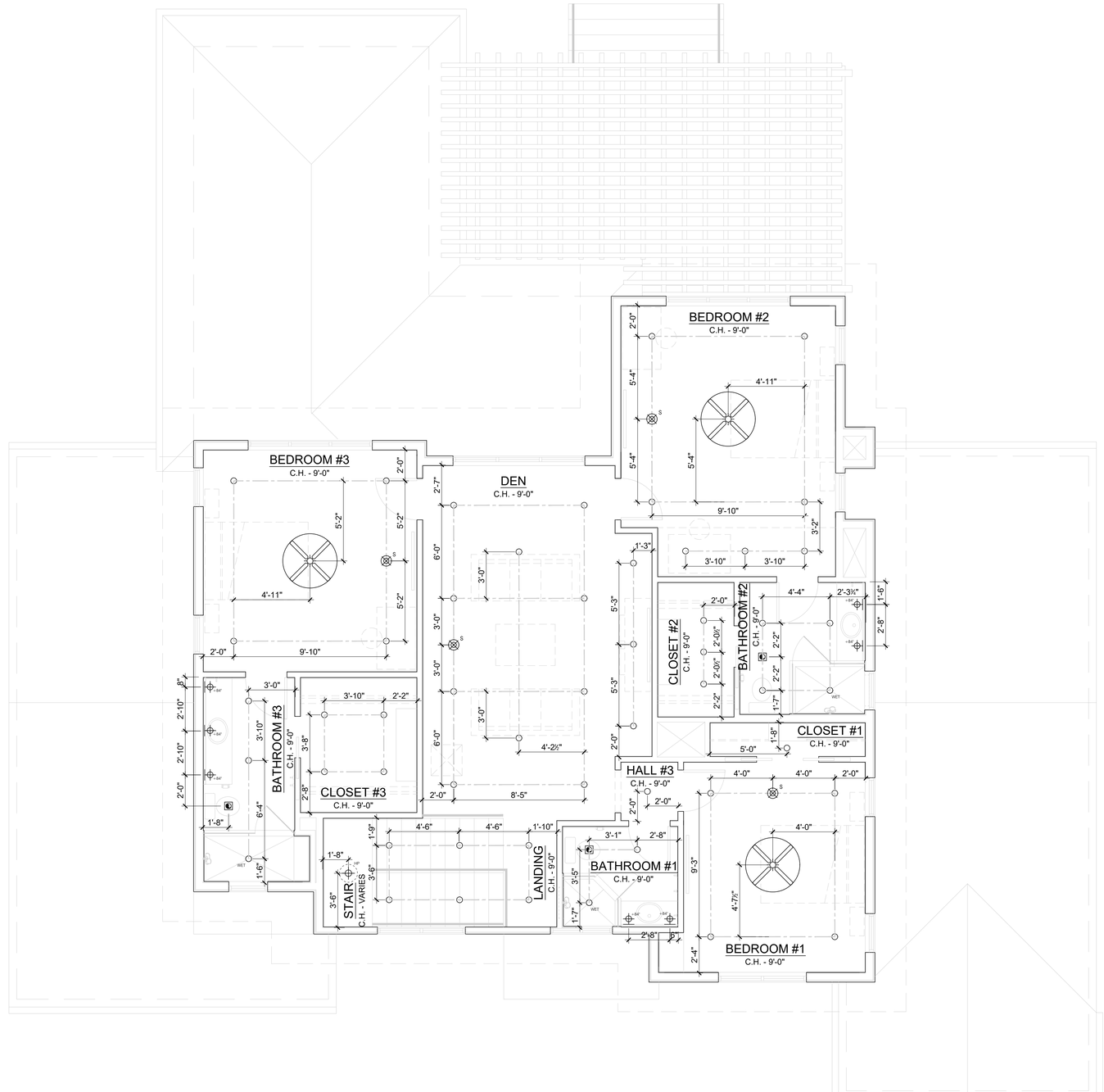

SECOND FLOOR REFLECTED CEILING PLAN

1

Scale 1/4" = 1'-0" (TABLOID:Scale 1/8" = 1'-0")

Revisions By

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Austin TX 78746

Project Address:
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West Lake Hills 78746

Contractor:
Captex Construction

2ND FLOOR REFLECTED CEILING PLAN

drawn by: MJS
checked by: NS
scale: 1/4" = 1'-0"
first issue: 06/19/2025
plot date: 06/19/2025

PERMIT SET

E2.1

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DETAIL
SCALE: 3/4"=1'-0" ON 22x34
SCALE: 3/8"=1'-0" ON 11x17

2 STAIRS
SCALE: 3/4"=1'-0" ON 22x34
SCALE: 3/8"=1'-0" ON 11x17

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

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June 16, 2025

Ewart Remodel and Addition

419 Ridgewood Road Austin, TX 78746

Job #	2025061602
Drn.	J. BUFKIN
Chk.	J. BUFKIN
Date	06-16-2025
Rev	

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NOTES

CODES

1. Building Code: International Residential Code 2021 Edition.
2. Structural Concrete: Building Code Requirements for Reinforced Concrete, American Concrete Institute, ACI 318-14.
3. Wood Framing: National Design Specifications for Wood Construction with Supplement, National Forest and Paper Products Association, Latest Edition.
4. Structural Plywood: Plywood Design Specifications, American Plywood Association, Latest Edition.

SUBSTITUTIONS

1. All requests for substitutions of materials or details shown in the contract documents shall be submitted for approval during the bidding period. Once bids are accepted, proposed substitutions will be considered only when they are officially submitted with an identified savings to be deducted from the contract.

BUILDING PAD

1. Prior to placing any fill material, remove all vegetation, clay and deleterious material to clean intact limestone. Bottom of exterior grade beams shall be founded on clean intact limestone. Bottom of grade beams shall have a slope less than or equal to 1 in 10. Under no circumstances shall concrete beams be placed on sloping limestone greater than 1 in 10 or limestone that is covered with loose deleterious fill material including topsoil, loose rocks, cruched rock or base material.
2. Grade adjustments within the building limits shall be accomplished with select fill soils meeting TxDOT standard specifications Item 247, Type A, Grade 4 (Crushed Limestone Base Material). All structural fill shall be placed on prepared surfaces in lifts not to exceed eight inches loose measure with compacted thickness not to exceed six inches. The fill shall be compacted to at least 95 percent of the ASTM 698 maximum dry density at a moisture conctent ranging between -2 and +3 percent of optimum moisture content.
3. Structural Fill shall be hard durable particles of gravel or crushed stone, with no organic material and shall meet the following criteria:

a.	Retained on 1 1/4" screen	0%
b.	Retained on 1" screen	0% to 5%
c.	Retained on 3/4" screen	0% to 30%
d.	Retained on 3/8" screen	5% to 70%
e.	Retained on No. 4 mesh sieve	20% to 70%
f.	Retained on No. 40 mesh sieve	30% to 85%

Material passing the No. 40 sieve shall meet the following plasticity requirements:

Maximum PI	Minimum PI	Maximum LL
15	3	35

4. Provide a 10 mil vapor barrier placed according to manufacturer's recommendations between the bottom of slab and the top of the select fill. Moisture barrier shall not be draped continuous across the bottom of grade beams.

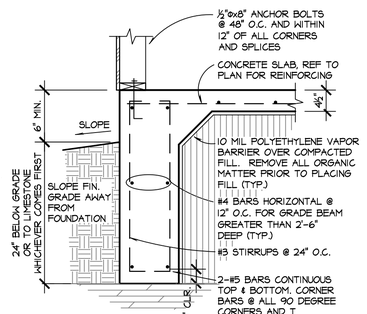
CAST IN PLACE CONCRETE

1. Cast in place concrete shall meet the following requirements:

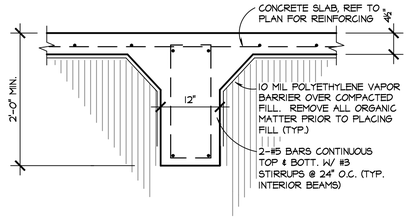
Class	28 Day Strength	Aggregate Type	Aggregate Size	Slump	Use
A	3000 psi	NW	1 1/2" max	3 to 5"	ALL

CONCRETE REINFORCING

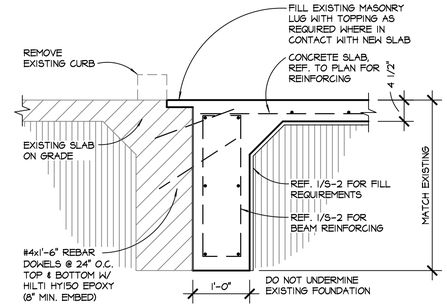
1. Reinforcing steel shall be deformed new billet steel bars in accordance with ASTM A615 Grade 60.
2. Provide reinforcing bars in accordance with the bar bending diagram if bar types are specified. In unscheduled beams, slabs, columns and walls detail reinforcing as follows:
   a. Lap top reinforcing bars at mid span.
   b. Lap bottom reinforcing bars at the supports.
   c. Lap vertical bars in columns and walls only at floor lines, unless noted otherwise.
   d. Lap reinforcing bars 36 bar diameters minimum, unless noted otherwise.
   e. Provide standard hooks in top bars at cantilever and discontinuous ends of beams, walls and slabs.
   f. Provide corner bars for all horizontal bars at the inside and outside faces of intersecting beams or walls. Corner bars are not required if horizontal bars are hooked.
3. Reinforcing steel clear cover shall be as follows:
   A. Grade beams - 1 1/2" top, 3" bottom, 2" side (formed), 3" side (placed against earth)



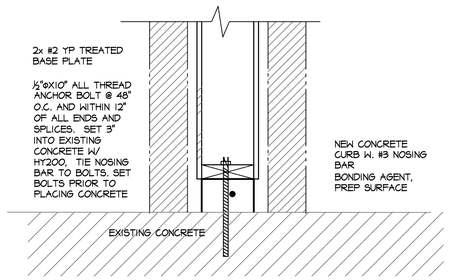
1 DETAIL
SCALE: 3/4"=1'-0" ON 22x34
SCALE: 3/8"=1'-0" ON 11X17



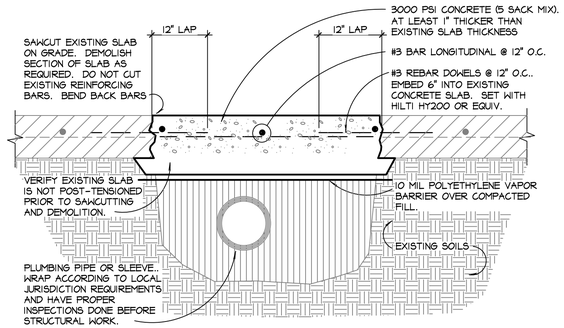
2 DETAIL
SCALE: 3/4"=1'-0" ON 22x34
SCALE: 3/8"=1'-0" ON 11X17



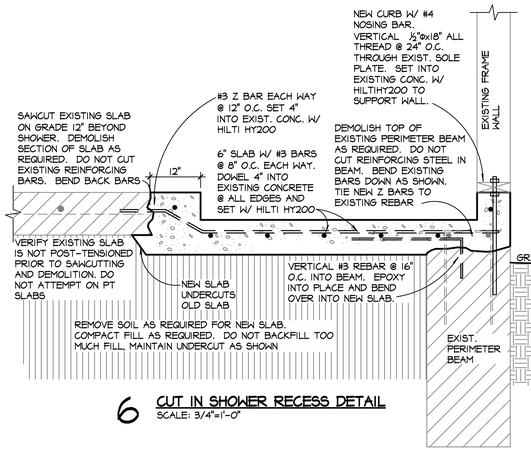
3 DETAIL
SCALE: 3/4"=1'-0" ON 22x34
SCALE: 3/8"=1'-0" ON 11X17



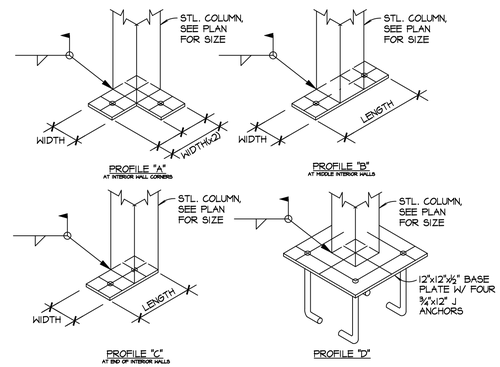
4 DETAIL
SCALE: 1 1/2"=1'-0" ON 22X34
SCALE: 3/4"=1'-0" ON 11X17



5 REPAIR DETAIL- PLUMBING TRENCHES
SCALE: 1 1/2"=1'-0"



6 CUT IN SHOWER RECESS DETAIL
SCALE: 3/4"=1'-0"



	COLUMN SIZE	PLATE DIMENSIONS WIDTH	PLATE DIMENSIONS LENGTH
"A"	HSS 4x4	4"	NA
	HSS 5x5	5"	NA
"B"	HSS 4x4	4"	12"
	HSS 5x5	5"	13"
"C"	HSS 4x4	4"	8"
	HSS 5x5	5"	9"
"D"	HSS 4x4	12"	12"
	HSS 5x5	12"	12"

	COLUMN SIZE	PLATE DIMENSIONS WIDTH	PLATE DIMENSIONS LENGTH
"A"	HSS 3x3	3"	NA
	HSS 6x6	6"	NA
"B"	HSS 3x3	3"	9"
	HSS 6x6	6"	14"
"C"	HSS 3x3	3"	6"
	HSS 6x6	6"	10"
"D"	HSS 3x3	12"	12"
	HSS 6x6	12"	12"

ALL BASE PLATES ARE MADE FROM ½" THK. A36 STEEL
W/ ⅝"ø x 8" HILTI HY200 EPOXY BOLTS FOR ANCHORING OR EQUIV.
DO NOT USE WEDGE ANCHORS WITHIN 8" OF A CONCRETE EDGE

7 TYPICAL RESIDENTIAL BASE PLATES
SCALE: N.T.S.

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JAMES E. BUTKIN
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June 16, 2025

Ewart Remodel and Addition

419 Ridgewood Road Austin, TX 78746

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LAMINATED VENEER LUMBER

1. All LVL's shall be fabricated to standards set forth in the National Evaluation Service (NES) report no. NER-481 and shall provide minimum allowable design values of 2400 PSI in bending, 285 PSI in shear perpendicular to the glue line and 1,800,000 PSI in Modulus of Elasticity

2. Multiple LVL (more than 3) beams shall be bolted together full length with 1/2"ø through bolts at a spacing of 1.5 times the depth of the beam. Bolts shall be placed at top and bottom. All other multiple LVL beams shall be nailed together from each face with (2) 16d at 12" o.c. top and bottom.

WOOD FRAMING

1. Unless otherwise noted, all structural framing lumber shall be clearly marked no. 2 southern yellow pine or douglas fir.

2. All wood stud walls shall be full height without intermediate plate line unless detailed otherwise.

3. Provide double studs at all wall corners and on each side of all openings.

4. Floor sheathing: 1 1/8" grade tongue&groove SturdiFloor with exterior glue. Floor sheathing shall be adhered to the wood support members with a wet use subfloor adhesive, in addition to being nailed to the supports with 10d common nails at 6" on center at supported edges and 12" on center at intermediate supports. Stagger joints in sheathing.

5. Roof sheathing: 5/8" sheathing with exterior glue. Panels shall be continuous over two or more spans with the long dimension oriented perpendicular to the framing members. Nail with 8d common nails at 6" on center at supported edges and 12" on center at intermediate supports. Stagger joints in sheathing.

6. Solid sheath entire building in 7/16" OSB. Provide 2x blocking as required to support all panel edges. Nail with 8d common nails at 6" on center at supported edges and 12" on center at intermediate supports.

7. Solid 2x blocking or bandboard shall be provided at supports and cantilever ends of all wood joists, and between supports in rows not exceeding 8'-0" apart.

8. All framing members framing into the side of a header shall be attached using metal joist hangers sized and installed in accordance with the manufacturers recommendations for the size of joist supported.

9. Place a single plate at the bottom and a double plate at the top of all stud walls. Exterior sill plates shall be bolted to the foundation with 1/2" anchor bolts with a minimum embedment of 8" spaced at 4'-0" on center. Sill plates in contact with concrete or masonry shall be pressure treated with a preservative. All horizontal plates shall be #2 yellow pine.

10. Provide double joists under all interior partition walls oriented parallel to the joists.

11. All bolts and lag screws shall have standard washers. All anchor and expansion bolts used in wood to concrete connections in crawlspace areas shall be hot dip galvanized or stainless steel.

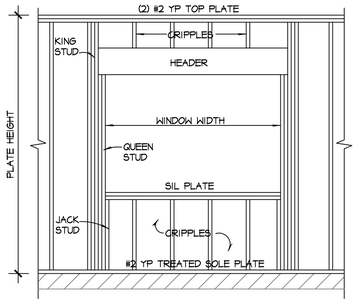
12. Refer to the architectural drawings for additional wood framing members. Provide additional wood framing members shown on the architectural drawings even though they may not be shown on the structural drawings.

DESIGN LOADS

1. Live Loads

a.	Single Family Residential	
	Typical u.n.o.	40 psf
	Sleeping Areas	30 psf
	Attic Space	10 psf
b.	Balconies	60 psf
c.	Stairs	100 psf
d.	Roof	16 psf
e.	Wind Lateral Load on Structural Frame: as per IBC requirements. 25 psf, Projected Area Method	

2. Dead Loads include the self weight of the structural elements.
   a. Roofing (Roofing) 10 psf



FRAMING DETAIL
SCALE: NTS

TYPICAL FRAMED OPENING SCHEDULE

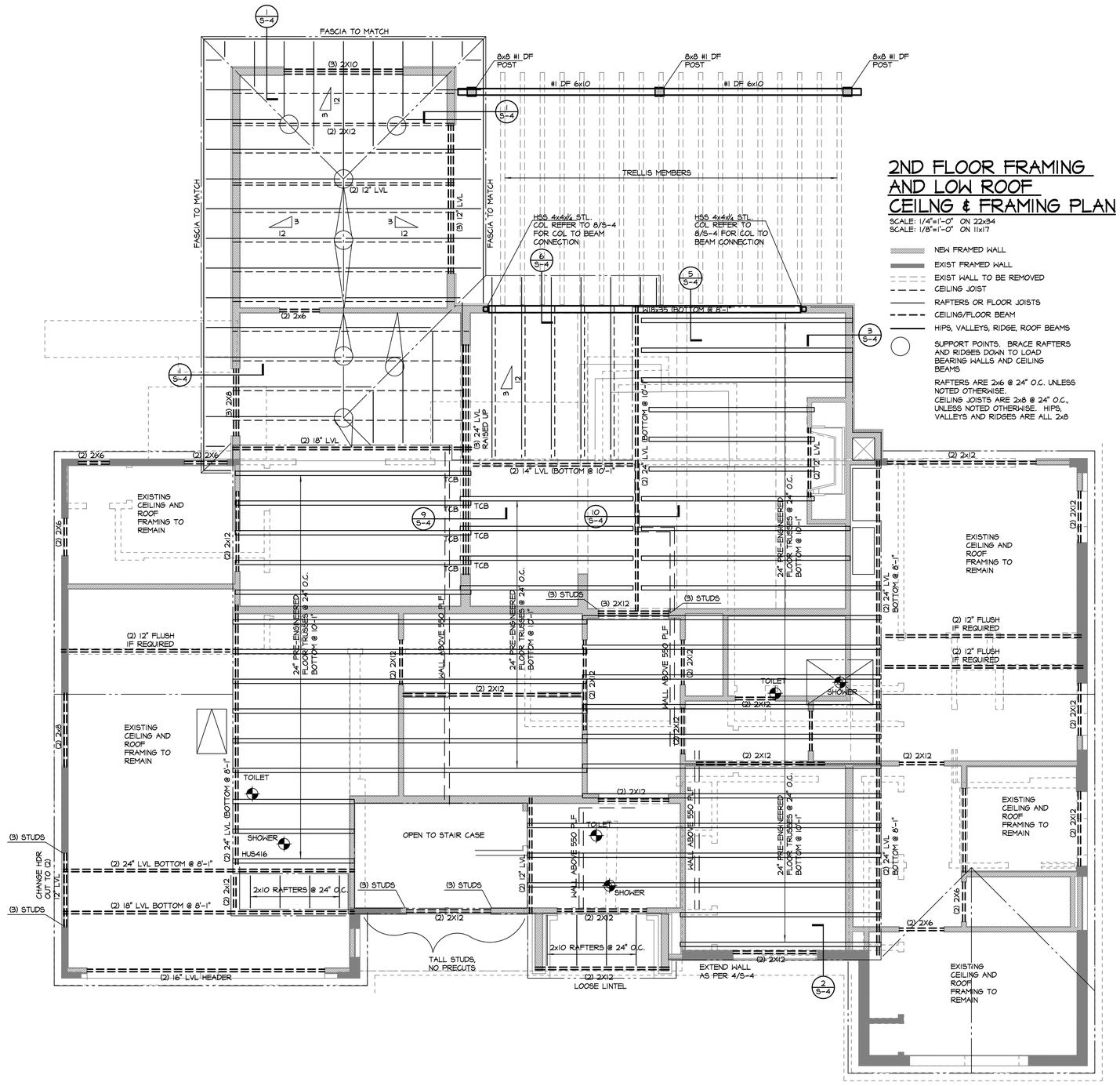
WINDOW WIDTH	NUMBER OF STUDS AT EACH SIDE OF WINDOW			# SIL PLATE
	KING	QUEEN	JACK	
< 3'-11"	1	1	1	1
4'-0" to 6'-5"	2	1	1	1
6'-6" to 9'-0"	3	2	1	1
9'-1" to 11'-11"	4	2	1	2
12'-0" to 14'-8"	5	2	1	2

CHART IS FOR 16" O.C. STUD SPACING.
DOUBLE ALL COUNTS FOR 8" O.C. SPACING

TYPICAL WALL FRAMING SCHEDULE

PLATE HEIGHT	SUPPORTING ROOF ONLY		SUPPORTING FLOOR AND ROOF	
	@ 16" O.C.	@ 8" O.C.	@ 16" O.C.	@ 8" O.C.
< 10'-2"	2x4	2x4	2x4	2x4
10'-2" to 14'-2"	2x6	2x4	2x6	2x6
14'-2" to 16'-2"	2x6	2x6	2x6	2x6
16'-2" to 20'-0"	N/A	2x6	N/A	2x6

ALL STUDS ARE SPF OR #2 YP.



2ND FLOOR FRAMING AND LOW ROOF CEILNG & FRAMING PLAN

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

- NEW FRAMED WALL
- EXIST FRAMED WALL
- EXIST WALL TO BE REMOVED
- CEILING JOIST
- RAFTERS OR FLOOR JOISTS
- CEILING/FLOOR BEAM
- HIPS, VALLEYS, RIDGE, ROOF BEAMS
- SUPPORT POINTS. BRACE RAFTERS AND RIDGES DOWN TO LOAD BEARING WALLS AND CEILING BEAMS

RAFTERS ARE 2x6 @ 24" O.C. UNLESS NOTED OTHERWISE.
CEILING JOISTS ARE 2x8 @ 24" O.C., UNLESS NOTED OTHERWISE. HIPS, VALLEYS AND RIDGES ARE ALL 2x8

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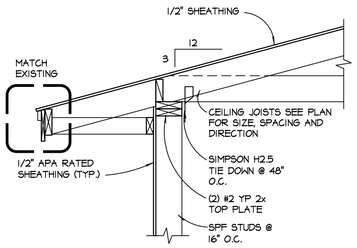
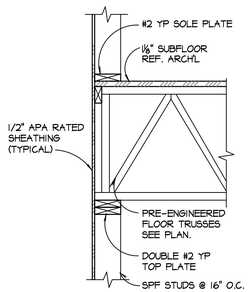
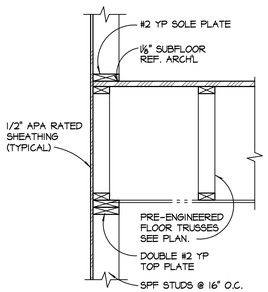
Sheet
S-3
Of 5



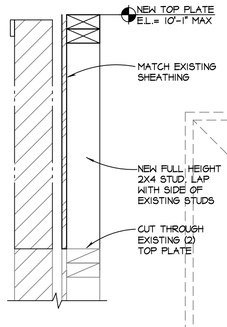
1 **DETAIL**
SCALE: ¾"=1'-0" ON 22x34
SCALE: ⅜"=1-0" ON 11X17



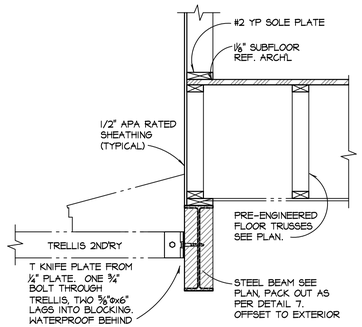
2 **DETAIL**
SCALE: ¾"=1'-0" ON 22x34
SCALE: ⅜"=1-0" ON 11X17



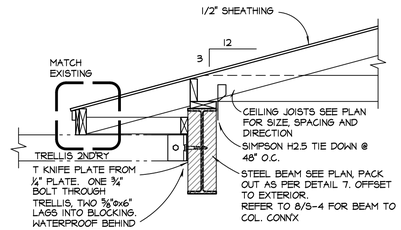
3 **DETAIL**
SCALE: ¾"=1'-0" ON 22x34
SCALE: ⅜"=1-0" ON 11X17



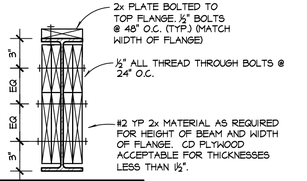
4 **WALL EXTENSION DETAIL**
SCALE: 1 1/2"=1'-0"



5 **DETAIL**
SCALE: ¾"=1'-0" ON 22x34
SCALE: ⅜"=1-0" ON 11X17

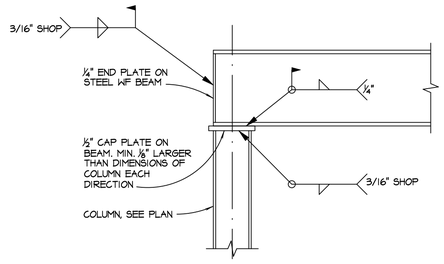


6 **DETAIL**
SCALE: ¾"=1'-0" ON 22x34
SCALE: ⅜"=1-0" ON 11X17

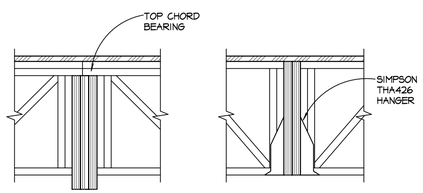


BEAM SIZE	# ROWS
6" TO 8"	1
10" TO 14"	2
16" TO 18"	3
21" TO 24"	4

7 **TYP. STEEL BEAM PACK OUT**
SCALE: 1"=1'-0"



8 **TYP. COLUMN TO WF BEAM CONNECTION DETAIL**
SCALE: 1 1/2"=1'-0"



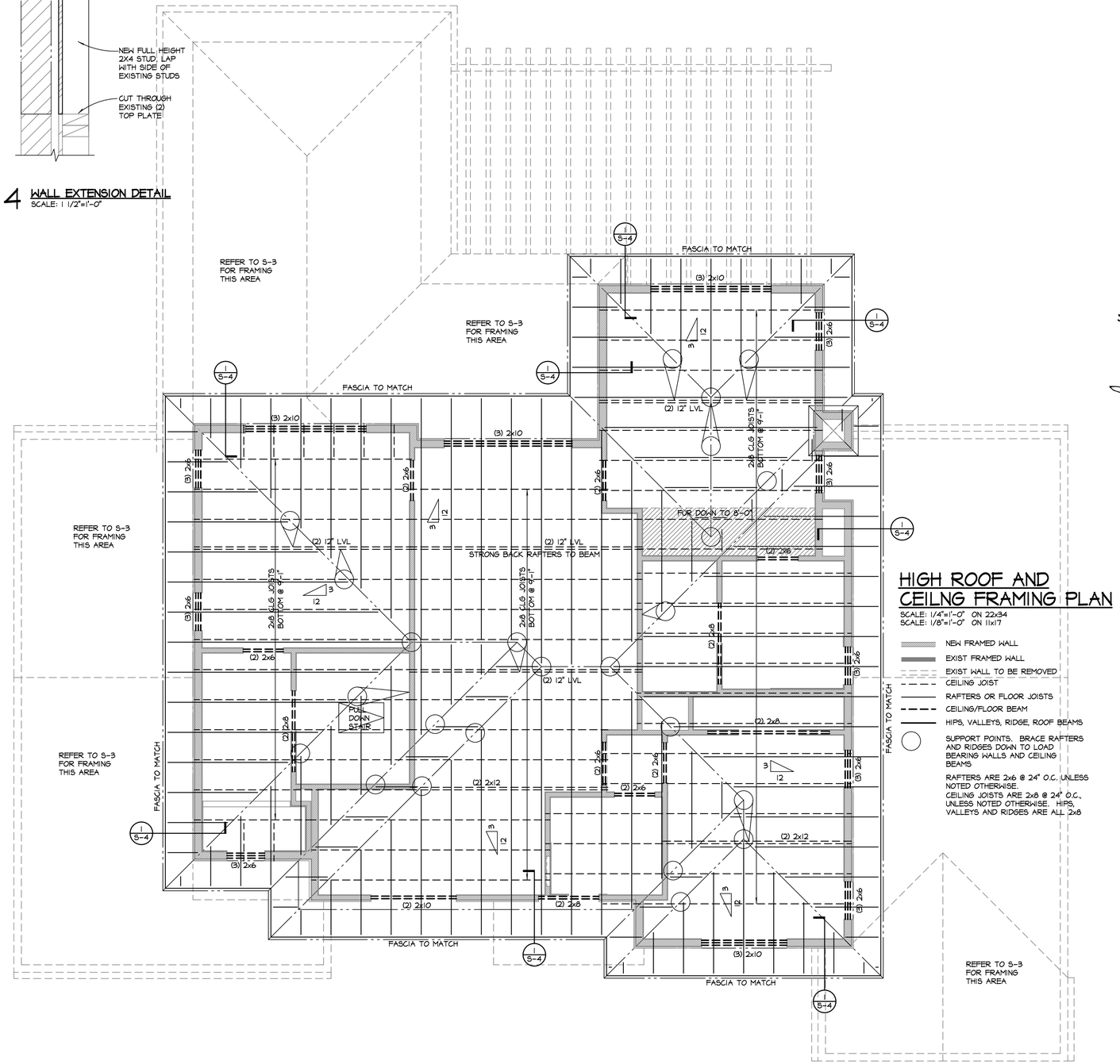
9 **DETAIL**
SCALE: ¾"=1'-0" ON 22x34
SCALE: ⅜"=1-0" ON 11X17

10 **DETAIL**
SCALE: ¾"=1'-0" ON 22x34
SCALE: ⅜"=1-0" ON 11X17

LOOSE LINTEL SCHEDULE

NOTE: PROVIDE 8" MINIMUM BEARING EACH END FOR STEEL LOOSE LINTELS. ONE ANGLE SHALL BE PROVIDED FOR EACH WYTHE OF BRICK. SEE ARCHITECTURAL DRAWINGS FOR LOCATION. STEEL LINTELS SHALL BE GALVANIZED EXCEPT AT THOSE LOCATIONS NOTED OTHERWISE. BOLT THROUGH LOOSE LINTEL INTO HEADER BEYOND WITH ½"ø BOLTS @ 48" O.C.

MASONRY OPENING	SIZE	DETAIL
LESS THAN 5'-0"	L3½"x3½"x¼" LLV	
5'-0" BUT LESS THAN 6'-6"	L4"x3½"x¼" LLV	
6'-6" BUT LESS THAN 8'-0"	L5"x3½"x¼" LLV	
8'-0" BUT LESS THAN 10'-0"	L6"x3½"x¼" LLV	
10'-0" BUT LESS THAN 11'-0"	C6X8.2 W/ ¼" PL.	
11'-0" BUT LESS THAN 13'-0"	C7X9.8 W/ ¼" PL.	
13'-0" BUT LESS THAN 15'-0"	C8X11.5 W/ ¼" PL.	
15'-0" BUT LESS THAN 17'-0"	C9X13.4 W/ ¼" PL.	
17'-0" BUT LESS THAN 19'-0"	C10X15.3 W/ ¼" PL.	
19'-0" BUT LESS THAN 23'-0"	C12X20.7 W/ ¼" PL.	
23'-0" BUT LESS THAN 24'-0"	C12X25 W/ ¼" PL.	
24'-0" BUT LESS THAN 25'-0"	C12X30 W/ ¼" PL.	
25'-0" BUT LESS THAN 30'-0"	C15X33.9 W/ ¼" PL.	



HIGH ROOF AND CEILNG FRAMING PLAN

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

NEW FRAMED WALL
EXIST FRAMED WALL
EXIST WALL TO BE REMOVED
CEILING JOIST
RAFTERS OR FLOOR JOISTS
CEILING/FLOOR BEAM
HIPS, VALLEYS, RIDGE, ROOF BEAMS
SUPPORT POINTS, BRACE RAFTERS AND RIDGES DOWN TO LOAD BEARING WALLS AND CEILING BEAMS

RAFTERS ARE 2x6 @ 24" O.C. UNLESS NOTED OTHERWISE.
CEILING JOISTS ARE 2x8 @ 24" O.C., UNLESS NOTED OTHERWISE. HIPS, VALLEYS AND RIDGES ARE ALL 2x8

Buffkin Engineering, Inc.
2309 West 8th Street Austin, Texas 78703
Ph: (512) 236-8070 Firm #9955 Cell: (512) 914-2659

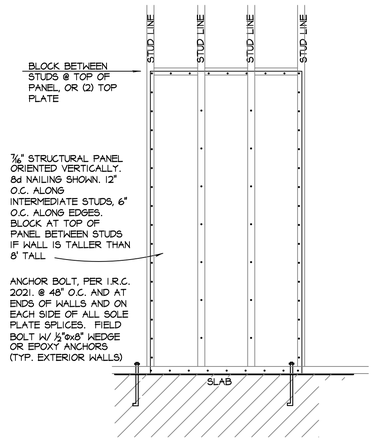
James E. Buffkin
STATE OF TEXAS JAMES E. BUFFKIN 87221 LICENSED PROFESSIONAL ENGINEER
June 16, 2025

Ewart Remodel and Addition

419 Ridgewood Road Austin, TX 78746

Job #	2025061602
Drn.	J. BUFKIN
Chk.	J. BUFKIN
Date	06-16-2025
Rev	

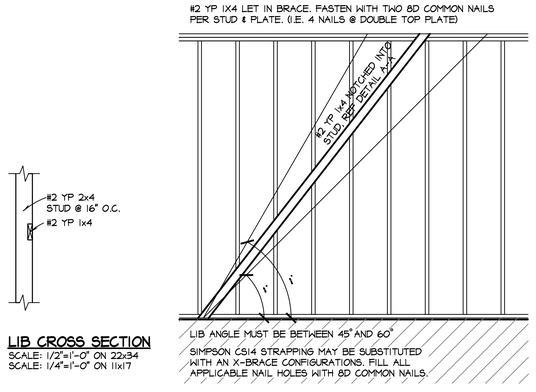
Sheet
S-4
Of 5



CS-WSP VERTICAL APPLICATION

SCALE: 1/2"=1'-0" ON 22x34
SCALE: 1/4"=1'-0" ON 11x17

REFER TO PLAN FOR LOCATION OF ANY REQUIRED HOLDDOWNS



A–A **LIB CROSS SECTION**
SCALE: 1/2"=1'-0" ON 22x34
SCALE: 1/4"=1'-0" ON 11x17

2 **LIB DETAIL**
SCALE: 1/4"=1'-0" ON 22x34
SCALE: 1/8"=1'-0" ON 11x17

WALL BRACING NOTES

CODES

1. Building Code: International Residential Code 2021 Edition. Section R602.10

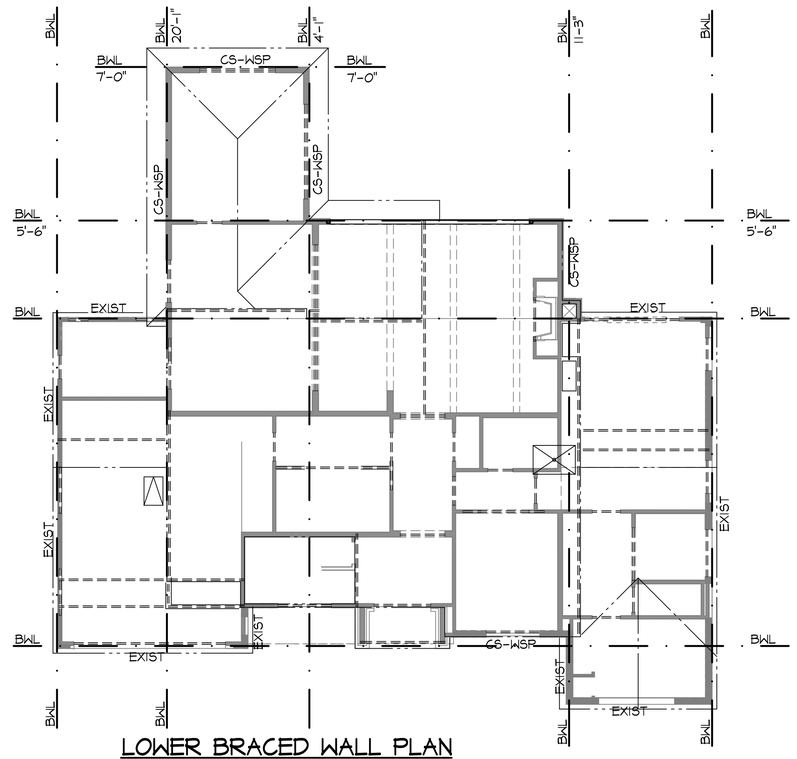
WALL BRACING LEGEND

CS-WSP Solid sheath entire building in 7/16" to ½" wood paneling and fasten with 8d common nails at 6" on center at supported edges and 12" on center at the intermediate supports. Staples not allowed on CS-WSP walls. Horizontal block all wood panels.

BWL = BRACED WALL LINE
##'-#"=TOTAL LENGTH OF CONTRIBUTING PANELS ON BRACED WALL LINE

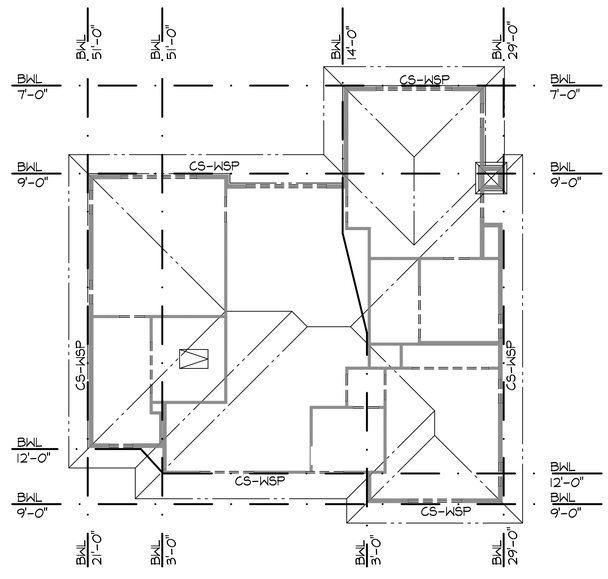
BWL Braced wall line

LIB 1x4 diagonal wood bracing continuous from top plate to bottom plate or approved metal straps at 45 to 60 degree angles for 16" stud spacing. Install straps as per manufacturer's requirements. Intermittent braced walls must have ½" gypsum wall board installed on side of wall opposite the bracing material.



LOWER BRACED WALL PLAN

SCALE: 1/8"=1'-0" ON 22x34
SCALE: 1/16"=1'-0" ON 11x17



UPPER BRACED WALL PLAN

SCALE: 1/8"=1'-0" ON 22x34
SCALE: 1/16"=1'-0" ON 11x17

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2309 West 8th Street Austin, Texas 78703
Ph: (512) 236-8070 Firm #9955 Cell: (512) 914-2659

James E. Buffkin
June 16, 2025

Ewart Remodel and Addition

419 Ridgewood Road Austin, TX 78746

Job #	2025061602
Drn.	J. BUFKIN
Chk.	J. BUFKIN
Date	06-16-2025
Rev	

Sheet S-5 Of 5

City of West Lake Hills

MINUTES OF A ZONING & PLANNING COMMISSION (ZAPCO)
REGULAR MEETING
Wednesday, March 18, 2026 at 6:30 PM

1. **Call to Order: Chair Robert Meisel**
    a. Meeting begins at 6:30pm
    b. Roll Call
        1. Chair Robert Meisel: Present
        2. Vice-Chair Jim Pledger: Present
        3. Commissioner Julia Webber: Present
        4. Commissioner Karen Bartoletti: Present
        5. Commissioner Patrick Stewart: Absent
        6. Commissioner Laurie Maccini: Absent

2. **Citizen Communications:**
    a. No public comments.

3. **Consent Agenda:** The following items are considered to be self-explanatory by the Commission and will be enacted with one motion. There will be no separate discussion of these item/s unless a Commission Member or citizen so requests.
    a. Approval of the February 18, 2026 Zoning and Planning Commission Minutes.
    b. Report of previous cases ZAPCO acted on by BOA/City Council.

    Action: Commissioner Pledger moves for approval of the Consent Agenda

    i. Commissioner Webber Seconds
    ii. Motion carries unanimously (3–0)

4. **102 Swiftcurrent**. Discuss and consider a recommendation to Board of Adjustments on a variance to allow a second driveway when a maximum of one is allowed (Section 22.03.175(e)(2))

    Applicant: Catherine Wilkes, 98 Swiftcurrent Property Owner & Francisco Rios, 102 Swiftcurrent Property Owner

    Note: the applicants provided additional exhibits to the commission at the ZAPCO hearing. These documents are attached to the minutes as exhibit 4A.

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a. **Staff Report:**
    1. Director Bills explains that the item was initially presented at the February ZAPCO meeting as a variance for 102 Swiftcurrent Trail, but was postponed to the March ZAPCO meeting to allow for 98 Swiftcurrent to be added to the application, as the intent is to secure the variance prior to transferring the land for the driveway to 98 Swiftcurrent Trail.
    2. Commissioner Webber asks Director Bills about the trees affected by the driveway .
    3. Chair Meisel asks why the applicants are selling their land for the driveway instead of securing an easement from 102 Swiftcurrent.
        1. Director Bills explains this is the desire of the property owners and the land would need to be replatted following the transfer of land, and a private easement would be recorded.

b. **Public Comment:**
    1. Christian Bigham – David Wilkes Builders
        1. Speaks on the variance request on behalf of applicants for 98 Swiftcurrent.
    2. Joseph Lucas - 100 Swiftcurrent:
        1. Speaks in opposition to the variance request.
    3. Francisco Rios, Applicant for 102 Swiftcurrent:
        1. Speaks in favor of the variance request.

c. **Discussion:**
    1. Commissioner Pledger points out that the applicants are in active litigation with the owners of 100 Swiftcurrent regarding the easement.
    2. Commissioner Webber believes the solution to put in a second driveway cut for a new easement seems like a no-brainer.
    3. Chair Meisel states that 100 Swiftcurrent does not need a second driveway
        1. Director Bills explains that the second driveway request is for a portion of property that is currently on 102 Swiftcurrent, but will be on 98 Swiftcurrent following the land transfer, but that the driveway is intended to be for access to 100 Swiftcurrent, which is a landlocked parcel.

d. **Action:** Commissioner Webber moves to recommend that the variance be forwarded to the Board of Adjustments with a recommendation of **approval** due to hardship.
    1. Commissioner Bartoletti seconds
    2. Motion **carries** unanimously (3-0)

The recommendation will be forwarded to the April 8th Board of Adjustments meeting

DRAFT

5. Public Hearing: **419 Ridgewood Trail:** Discuss and make a recommendation on proposed variances for the removal of one tree (14.25 inch elm) with a trunk diameter of 14 inches or greater, (Section 22.03.304 of the West Lake Hills Code).

   Applicant: Nina Falgout Sterrett, Atterberry Cooke Architecture

   a. **Staff Report:**
      1. Director Bills shares the presentation about the tree removal
      2. Commissioner Webber asks if staff has gone to inspect the tree
         1. Director Bills states that staff inspected the trees at the beginning of the project, but not since

   b. **Public Comment:**
      1. Nina Falgout Sterrett, Applicant:
         1. Speaks in favor of the variance request
      2. Doug Dear, Certified Arborist:
         1. Explains that the tree is structurally unsound following the authorized removal of surrounding smaller trees, which exposed the tree to wind loads.

   c. **Discussion:**
      1. Commissioner Bartoletti asks about the arborist's letter and if the tree is structurally unsound
         1. Doug Deer states that the tree is structurally unsound
      2. Commissioner Webber asks about the mitigation for the 14.25" tree and asks Director Bills what the homeowner could possibly do to mitigate for the tree.
         1. Commissioner Webber discusses a possible update to the City's tree ordinance to potentially avoid similar variance requests in the future.

   d. **Action:** Commissioner Pledger moves to forward the variance request to City Council with a recommendation of **approval**.
      1. Commissioner Bartoletti seconds
      2. The motion **carries** unanimously (3-0)

6. Public Hearing: Discuss and consider action to make a recommendation to City Council on the adoption of the amended Drainage and Erosion Control Design Manual

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a. **Staff Report:** City Engineer Christopher Otto with Colliers Engineers delivers a presentation on the proposed updates to the Drainage and Erision Control Design Manual
    1. City Engineer Otto states the changes to types of drainage plans, removing the type iii permit and consolidating type II and type III
    2. Chair Meisel asks for clarification regarding the water courses
    3. Christopher Otto shares the updates to the impervious cover table
    4. Chair Meisel requests clarification regarding about rainwater capturing in relation to the impervious cover of materials such as turf
        1. City Engineer Otto clarifies that the underdrain system under turf catches the rainwater
    5. Commissioners Webber and Pledger ask about the impervious cover for crushed gravel
    6. Chair Meisel and Commissioner Pledger ask about rainwater harvesting impervious coverage
        1. Director Bills clarifies that the rainwater collection is for TCEQ water quality requirements, not for detention.
        2. City Engineer Otto clarifies that rainwater collection for water quality only accounts for the “first flush” of rainfall in which surface pollutants are carried by running water, so only collect and treat the first 1.5 inches of rainfall. 100-year floods in the region can include 12 inches or more of rainfall.
    7. Commissioner Bartoletti requests clarification on no-objection certificates
        1. City Engineer Otto explains that the downstream neighbor is the signatory on the no-objection certificate.
        2. Commissioners Webber and Bartoletti express reservations about the no-objection certificate, and that the process could place neighbors in an awkward position.
    8. Commissioner Webber asks about requirements for Natural Water Courses.
        1. Commissioner Webber asks if there is a visual way to show that a property is close to a natural water course.
    9. Commissioner Bartoletti asks if the limestone topography plays any part of likely flood areas and drainage fields
        1. City Engineer Otto explains that there are methods to take the limestone into account, but that is an expensive and difficult process and the intent of the proposed manual is not to pass the burden of those methods onto homeowners
    10. Commissioner Webber asks about the depth or radius of the cut and fill piers
    11. Commissioner Webber asks about cut and fill for septic fields

DRAFT

1. Director Bills shares that cut and fill are considered in septic reviews and that septic fields are not allowed on a slope greater than 30% by TCEQ regulations

12. Commissioner Webber asks about the drainage checklist and recommends clarity between the Type I and Type iII drainage elements
    1. Director Bills states that the drainage checklist currently includes site plan elements, and upcoming updates will reverse this and have the drainage checklist be a subset to site plan checklists
13. Chair Meisel asks Director Bills what recommendations they should move forward and when they are moving forward
    1. Director Bills clarifies that City Council will consider the drainage manual for adoption on the April 8 Meeting, following recommendation from ZAPCO
    2. Commissioner Webber asks how they can make recommendations regarding checklists that haven't been prepared
        a. Director Bills clarifies that checklists are administrative items and will be prepared following adoption of the manual.

b. Action: Chair Meisel moves that the drainage manual be recommended for adoption by the City Council, with the request that council discuss:

a) The impervious cover status of crushed granite walkways;
b) The wisdom of the no-objection certificates considering their impact on adjacent neighbors;
c) Providing a water course location map and notifying property owners of their status; and
d) The impact of piers and their sizing on the environment.

1. Commissioner Webber Seconds
    1. The motion **carries** unanimously (3-0)

7. **Adjournment**

Chair Meisel adjourns the meeting at 8:20pm

APPROVED:

_____

Robert Meisel, Chair

ATTEST:

DRAFT

_____

Joel Sherrouse, Development Coordinator

These minutes were approved on _____, 2026.

DRAFT

Exhibit 4A

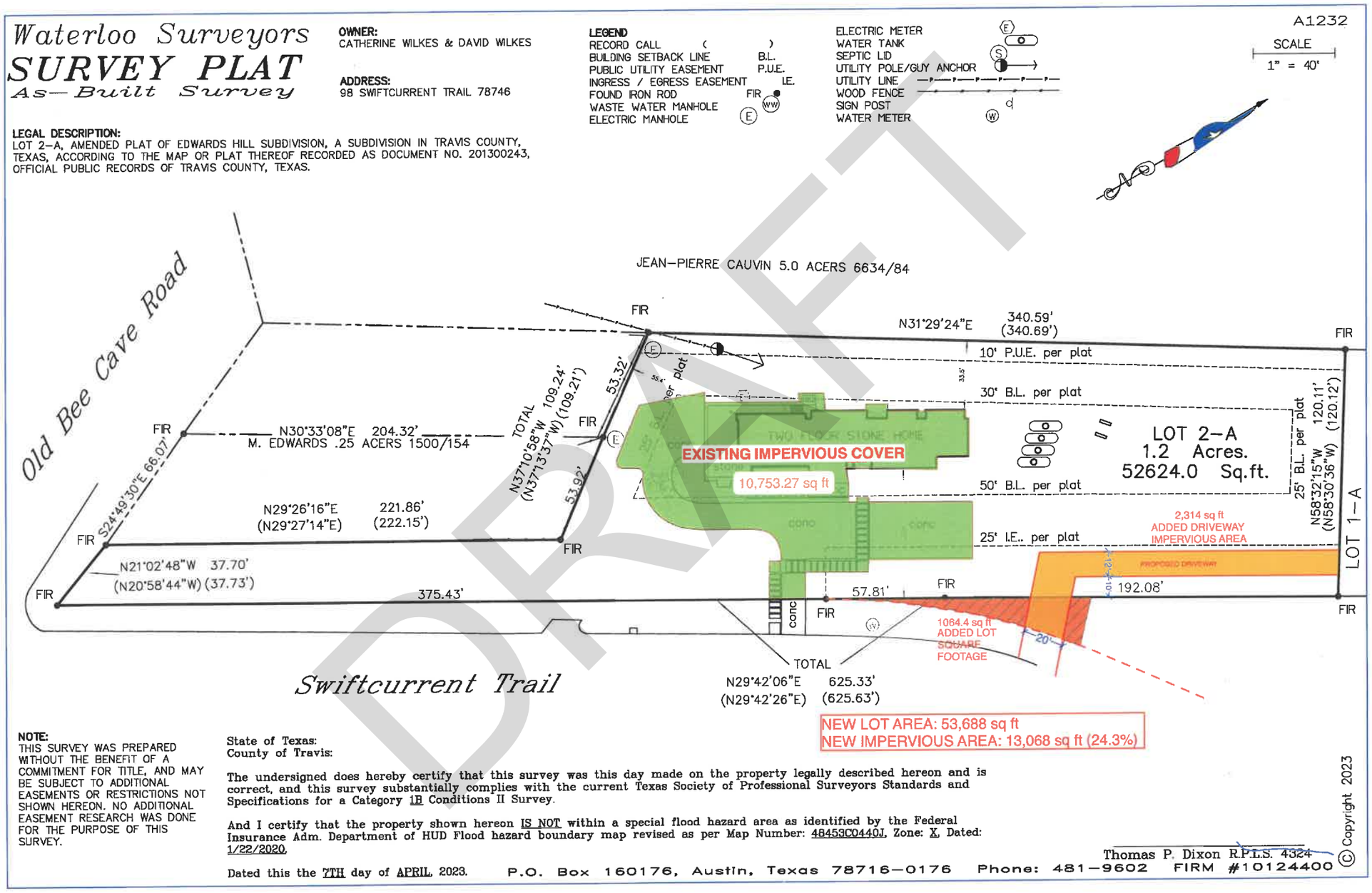
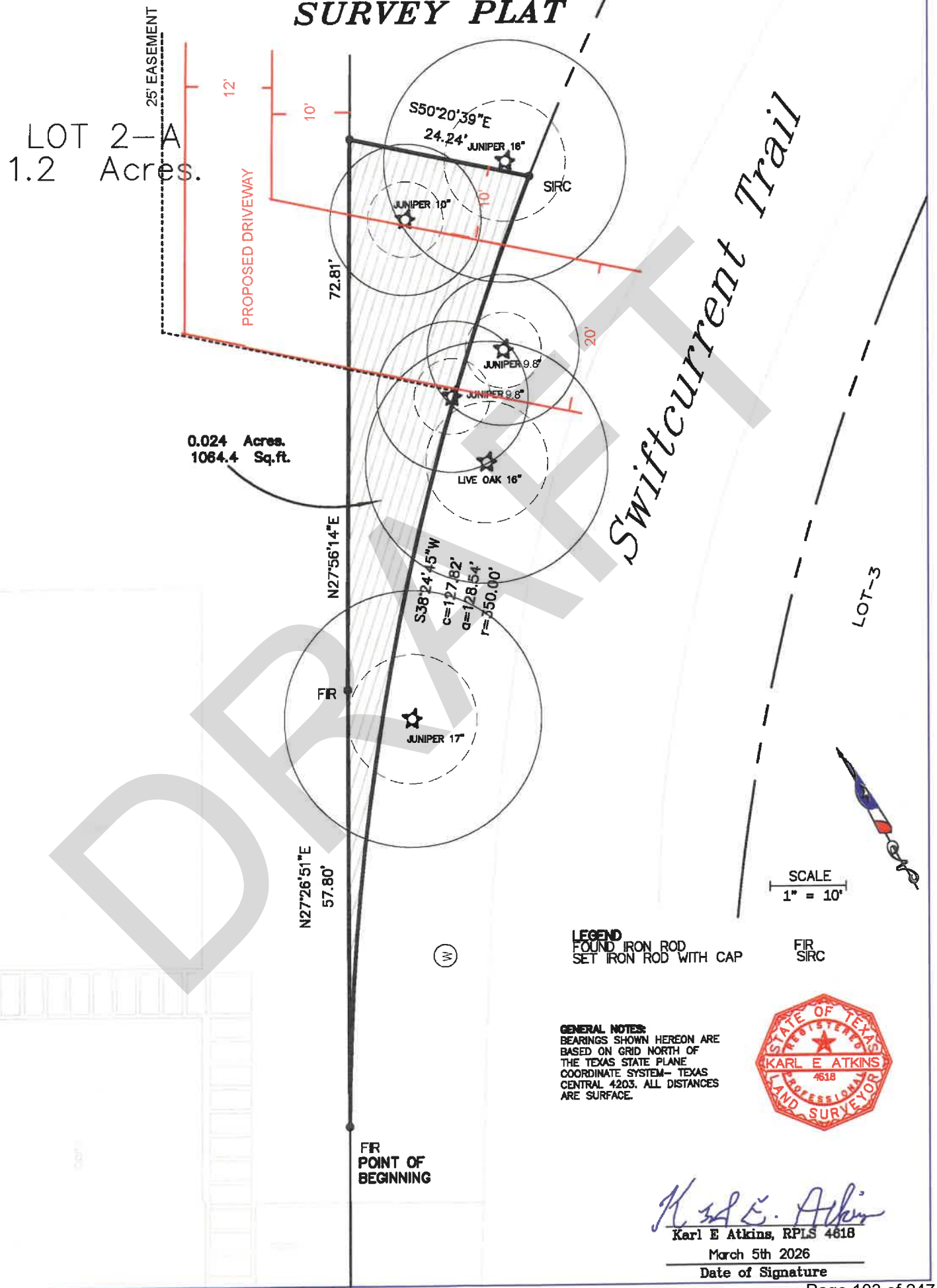

Waterloo Surveyors
SURVEY PLAT
As—Built Survey
OWNER:
CATHERINE WILKES & DAVID WILKES
ADDRESS:
98 SWIFTCURRENT TRAIL 78746
LEGEND
RECORD CALL ( )
BUILDING SETBACK LINE B.L.
PUBLIC UTILITY EASEMENT P.U.E.
INGRESS / EGRESS EASEMENT I.E.
FOUND IRON ROD FIR
WASTE WATER MANHOLE
ELECTRIC MANHOLE
ELECTRIC METER
WATER TANK
SEPTIC LID
UTILITY POLE/GUY ANCHOR
UTILITY LINE
WOOD FENCE
SIGN POST
WATER METER
A1232
SCALE
1" = 40'
LEGAL DESCRIPTION:
LOT 2—A, AMENDED PLAT OF EDWARDS HILL SUBDIVISION, A SUBDIVISION IN TRAVIS COUNTY, TEXAS, ACCORDING TO THE MAP OR PLAT THEREOF RECORDED AS DOCUMENT NO. 201300243, OFFICIAL PUBLIC RECORDS OF TRAVIS COUNTY, TEXAS.
JEAN—PIERRE CAUVIN 5.0 ACERS 6634/84
Old Bee Cave Road
Swiftcurrent Trail
N31°29'24"E 340.59' (340.69')
10' P.U.E. per plat
30' B.L. per plat
50' B.L. per plat
25' I.E.. per plat
25' B.L. per plat
N58°32'15"W 120.11' (N58°30'36"W) (120.12')
LOT 2—A
1.2 Acres.
52624.0 Sq.ft.
LOT 1—A
EXISTING IMPERVIOUS COVER
10,753.27 sq ft
TWO FLOOR STONE HOME
2,314 sq ft
ADDED DRIVEWAY
IMPERVIOUS AREA
PROPOSED DRIVEWAY
1064.4 sq ft
ADDED LOT
SQUARE
FOOTAGE
N30°33'08"E 204.32'
M. EDWARDS .25 ACERS 1500/154
S24°49'30"E 66.07'
N29°26'16"E (N29°27'14"E) 221.86' (222.15')
N21°02'48"W 37.70' (N20°58'44"W) (37.73')
375.43'
TOTAL N37°10'58"W 109.24' (N37°13'37"W) (109.21')
53.32'
53.92'
57.81'
192.08'
TOTAL N29°42'06"E 625.33' (625.63')
N29°42'26"E)
NEW LOT AREA: 53,688 sq ft
NEW IMPERVIOUS AREA: 13,068 sq ft (24.3%)
NOTE:
THIS SURVEY WAS PREPARED WITHOUT THE BENEFIT OF A COMMITMENT FOR TITLE, AND MAY BE SUBJECT TO ADDITIONAL EASEMENTS OR RESTRICTIONS NOT SHOWN HEREON. NO ADDITIONAL EASEMENT RESEARCH WAS DONE FOR THE PURPOSE OF THIS SURVEY.
State of Texas:
County of Travis:
The undersigned does hereby certify that this survey was this day made on the property legally described hereon and is correct, and this survey substantially complies with the current Texas Society of Professional Surveyors Standards and Specifications for a Category 1B Conditions II Survey.
And I certify that the property shown hereon IS NOT within a special flood hazard area as identified by the Federal Insurance Adm. Department of HUD Flood hazard boundary map revised as per Map Number: 48453C0440J, Zone: X, Dated: 1/22/2020.
Dated this the 7TH day of APRIL, 2023.
Thomas P. Dixon R.P.L.S. 4324
P.O. Box 160176, Austin, Texas 78716—0176 Phone: 481—9602 FIRM #10124400
© Copyright 2023
DRAFT

Exhibit 4A

Waterloo Surveyors

SURVEY PLAT

A1232



Karl E Atkins, RPLS 4618

March 5th 2026

Date of Signature

DRAFT

Exhibit A

419 Ridgewood- Tree Variance

Applicant's Findings of Fact

1. **The strict or literal enforcement of the terms of this chapter, because of special conditions, will result in unnecessary hardship to the applicant**.
   The existing tree is in fair condition and poses a threat to construction activities and the proposed residence. It's removal and replacement will protect those working on site and the Owner's investment.

2. **There will not be unreasonable disruption of the natural terrain or unreasonable destruction of existing flora.**
   The disruption is not unreasonable given the health and instability of Tree 1835. As it stands, it is a liability.

3. **There is no reasonable alternative to the requisite variance that will alleviate the difficulty or hardship complained of.**
   Leaving the tree and waiting for its failure will mean it is an ongoing threat to construction activities and the proposed house. The tree has a previous repair attempt that was incomplete, making it a poor candidate for additional remediation steps.

4. **The variance will not be greater than the minimum required to alleviate the difficulty or hardship complained of.**
   We believe the location of the tree, adjacent to the proposed construction, it poses a hazard to life and property. Trimming it or providing it additional support will not alleviate this threat. It's removal is necessary.

5. **The variance does not violate the intent of the Zoning Ordinance or goals of the Comprehensive Plan.**
   We don't believe it is the goal of the City to require the Owner's to maintain a tree that poses a threat to life and property. This tree is at the center of the site and behind the proposed house. Although it's removal will impact the public domain (view from the street) we believe this impact will be mitigated by the installation of healthy, replacement trees.

6. **The variance will not adversely affect neighboring properties or interfere with the enjoyment of these properties by their owners**.
   This tree is at the center of the site and behind the proposed house. Although it's removal will impact the public domain (view from the street) and neighbors (view from adjacent properties) we believe this impact will be mitigated by the installation of healthy, replacement trees.

City *of* West Lake Hills
City Council

AGENDA REPORT

Meeting Date:	April 8, 2026	**Item Number:**	7
Department:	Building & Development		
Prepared By:	Jennifer C. Bills	**Cost / Budget:**	None
Exhibits:	See Attached	**Source of Funds:**	N/A

Subject

Discuss and consider action to adopt Ordinance 2026-003 to amend the Drainage and Erosion Control Design Manual.

Recommendation

Hold a public hearing and take action on the adoption of Ordinance 2026-003 to amend the Drainage and Erosion Control Design Manual.

Discussion

The drainage manual focus group was designated by Mayor Vaughan in 2024 to review and make recommendations for revisions to the adopted Drainage and Erosion Control Design Manual (DECDM). The DECDM was first adopted in 2018 which helped consolidate site plans and site disturbance requirements that were otherwise scattered throughout the Code of Ordinances for residential and adopted the City of Austin standards for commercial projects. The DECDM was amended in 2020 to adopt the FEMA Atlas 14 rainfall data and increase the size of the project that qualified for a Residential Type I drainage review. The amount of added impervious cover increased from 400 sf to 1,000 sf to still qualify for Type I, which does not require a drainage study.

Colliers Engineering was contracted in June to fulfill the role of City Engineer. In this capacity, Colliers is responsible for assisting the city with development reviews, especially those with drainage and detention requirements established within the City Code and the City's DECDM.

Among the first task orders delegated to Colliers was to review and provide recommendations regarding improvements that should be considered related to drainage and detention requirements. They presented high level recommendations to the drainage focus group and at a City Council Workshop on October 1, 2025. The regulation of impervious cover is also integral to these matters and was also discussed by the architectural committee. With the direction provided, Colliers started the draft revisions, which were provided to ZAPCO for review and feedback at a workshop on January 7, 2026. In addition to the manual, the city engineer created additional flow charts and updated checklists to assist with drainage plan preparation and interpreting the DECDM.

The Zoning and Planning Commission reviewed the amendments to the DECDM (Attachment 1) on March 18, 2026 at their regular meeting. The Commission had four recommendations for specific consideration by the City Council before adoption.

1. The impervious cover status of crushed granite walkways.

a. As presented to ZAPCO, only manmade areas of loose rock/gravel sized 2”-8”, that do not have a compacted base, and not used for conveyance or storage of vehicles, and are sufficiently contained by edging counted as 0% impervious (entirely pervious).
b. ZAPCO discussed the allowance of crushed granite that would not count against the impervious cover percentage.

2. The wisdom of the no-objection certificates considering their impact on adjacent neighbors.
    a. The draft presented had an option for a property owner to furnish a “No objection” certification from an adjacent property owner that would be impacted by additional or modified drainage from a project.
    b. The Commission was concerned about the legality with state drainage laws and potential conflicts that may be created in the community from such requests and the impact to future property owners.

3. Providing a water course location map and notifying property owners of their status.
    a. With the discussion surrounding the ability of a project to directly discharge into an established stream/creek, the city engineer created a map of the tributaries where direct discharge may be allowed. This map includes streams that are not officially recognized as a US waterway or FEMA floodplain.
    b. The commission requested a map that would identify the properties that would be affected by the stream map drainage plan requirement. Staff stated that this map could be hosted as an interactive map that could be looked up by address).

4. The impact of piers and their sizing on the environment.
    a. The draft DECDM provided clarifying language that foundation walls for the house are included within the cut and fill limits in Table 9.1 Maximum Cut and Fill Limits, however development is still allowed when using a cantilever/pier system that leaves the majority of the land underneath the structure undisturbed.
    b. The Commission had concerns about limiting the size/depth of the piers allowed; that without limitation builders may use excessive excavation for construction.

The ZAPCO recommended approval of amending the Drainage and Erosion Control Design Manual, with comments that the City Council consider the four items listed, by a vote of 3-0 (two members absent).

The City Engineer has addressed the four comments in the current draft of the DECDM in the draft Attachment 2.

1. The impervious cover status of crushed granite walkways;
    a. Counted as 50% impervious - Provision for crushed granite and/or gravel paths installed over a geotextile fabric with a minimum 2-inch sand bedding layer and with proper edging to prevent erosion during a rain event.
        i. Cannot exceed 20% of front yard, maximum width of 3-feet.
        ii. Cannot exceed 20% of back yard. (Section 2.1.6 Impervious Cover Table 2-3)

2. The wisdom of the no-objection certificates considering their impact on adjacent neighbors;

a. Removed the no-objection certificate option and replaced with the standard practice of securing a permanent drainage easement for off-site drainage. (Chapter 6 Mitigation Options)

3. Providing a water course location map and notifying property owners of their status; and
    a. Watercourse map has been provided and shows relative proximity of land to defined area wet weather watercourses and streams. Forthcoming improvements to the map in support of the amendments will clearly identify parcels that fall within 100 feet of a dashed line / watercourse.

4. The impact of piers and their sizing on the environment.
    a. Staff discussed this comment with the city engineer. The direction provided is to not put any limits on the depth, size or number of piers, as these considerations are elements of a structural design that must be designed by a registered professional engineer, and adding limitations may unintentionally compromise the structural integrity of the project.

The City Council discussed several additional revisions at the April 1, 2026 workshop.

1. Add additional criteria to the Type I-R for projects up to 400 sf of additional impervious cover that are over 20%, restricted to the cumulative amount over a five-year period. Lots over 20% subject to TCEQ water quality regulations would still be required to have a Water Pollution Abatement Plan/Contributing Zone Plan or utilize rooftop rainwater collection. This would require restructuring the review fee structure so engineers can conduct the proper review. If changed, the residential flowchart would also be revised.
2. Remove the requirement that properties within 100 feet of a non-FEMA regulated watercourse would be automatically required to perform a Type II-R study and plan set. City engineer will provide reasoning behind the requirement and recommendation on the possible change.
3. Impervious Cover Definition Table
    a. Crushed granite – remove 20% maximum. All installations cannot be wider than 3 feet.
    b. Artificial turf – remove 25% maximum.
    c. Manmade loose gravel – reduce minimum size from 2-inches to 3/4-inch.

These possible changes are reflected in Attachment 5 for consideration.

Attachments:

- Attachment 1 – Drainage and Erosion Control Design Manual – Track Changes
- Attachment 2 - Residential Development Flowchart - Draft
- Attachment 3 - Non-Residential Development Flowchart - Draft
- Attachment 4 - Watercourse Exhibit
- Attachment 5 – Alternative Language based on Workshop feedback
- Ordinance No. 2026-003
- Exhibit A – Code of Ordinance Definitions and Amended Drainage and Erosion Control Design Manual

City of West Lake Hills

Drainage and Erosion Control Design Manual

~~May 2020~~

REVISION X.X. EFFECTIVE MONTH DAY, 2026

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CHAPTER 1 INTRODUCTION

The purpose of the Drainage and Erosion Control Design Manual is to establish standard principles and practices for the planning, design, construction, maintenance, and management of stormwaterdrainage, erosion control, and water quality facilities within the City of West Lake Hills and its ETJ. The policy statements of Chapter 2 provide the underlying principles by which all drainage facilities shall be designed. The application of the policy is facilitated by the technical criteria contained in the remainder of the manual.

1.1 Purpose and Scope

The design factors, formulas, graphs, and procedures described in this manual are intended to serve as guidelines for the design of drainage improvements and projects involving the volume, rate of flow, method of collection, storage, conveyance, treatment, and disposal of stormwater and erosion protection from stormwater flows. Responsibility for actual design remains with the design engineer.

This manual and the City of West Lake Hills Code of Ordinances (City Code) contain requirements for the design of infrastructure related to storm drainage, flood protection, water quality, and erosion control facilities. Where there is any conflict between this manual and the current City Code, the more restrictive shall take precedence. The design engineer is responsible for complying with the latest version of this manual and code adopted by the City.

If conflicts occur between City policy and criteria in this manual versus other regulatory authorities with jurisdiction in the same area, such as TCEQ, FEMA, or TxDOT, then the more stringent requirement will apply. Where applicable, other jurisdictional reviews may also be required in addition to that of the City.

1.2 Applicability

Stormwater policy and criteria in this manual shall apply to all drainage improvements and projects that may impact drainage or water quality, both publicly and privately funded, within the City and within its ETJ. Definitions, methods, criteria, procedures, and data in this manual have been developed to support the stormwater policy outlined in Chapter 2.

1.3 Waivers

The City Administrator, when petitioned for a waiver, may approve the waiver, deny the waiver, or make an initial determination and refer the matter to City Council for a variance. If the City Administrator approves the waiver, no additional approval by the City Council is neededrequired.

1.4 Amending the Manual

Amendments may be recommended by City Staff and approved, denied, or sent to City Council by the City Administrator. Notification and explanation shall be given to the City Council of all administratively approved amendments. Any member of the City Council may request that the administratively approved amendment be placed on a City Council meeting agenda for discussion and review. If a request for an administratively approved amendment to be placed on a City Council agenda is not received within ten days, the administratively approved amendment will immediately take effect.

1.5 References and Definition of Terms

At certain points in the text, the reader will encounter numbers enclosed in brackets, for example [1]. These numbers correspond to the references listed in Appendix A. Definitions of common terms used in this manual are provided in Appendix B. A list of abbreviations commonly used within this manual is in Table 1-1. For unfamiliar abbreviations not included in Table 1-1, the City of West Lake Hills may be contacted for the appropriate full, formal name associated with the abbreviation.

Table 1-1: List of Abbreviations

Abbreviation	Definition
AASHTO	American Association of State Highway and Transportation Officials
BMP	Best Management Practice
City	City of West Lake Hills
ETJ	Extraterritorial Jurisdiction
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Association
NRCS	Natural Resources Conservation Service
ROW	Right-of-way
TCEQ	Texas Commission on Environmental Quality
TPDES	Texas Pollutant Discharge Elimination System
TxDOT	Texas Department of Transportation
USACE	US Army Corps of Engineers

CHAPTER 2 DRAINAGE CRITERIA

This manual represents the application of accepted principles of surface drainage engineering and is a working supplement to information obtainable from standard drainage design handbooks, other publications on drainage design, and the City Code. The policy statements of this section provide the underlying principles by which all drainage improvements shall be designed. The application of the policy is facilitated by the technical criteria contained in the remainder of the manual.

2.1 Permit Submittal Components

The submittal components to be provided by the property owner, or agent, are determined by the requirements of this manual. Applications are also located on the City's website.

The development category shall be based on the type of development, impervious cover, and disturbed area of the development as shown in Table 2-1 and Table 2-2. The development category for an application shall be determined by the least restrictive category where all the criteria are met.

Table 2-1: Residential Development Categories

Category	Criteria
Residential Type I Development (Type I-R)	~~No Variances/Special Use Permits; and~~ No work within ~~drainage~~ public easements; and > 100-feet of a FEMA designated floodplain or regulated stream shown in Appendix C; and~~100 feet from a~~ <20% total site impervious cover; and < 1,000 SF of additional impervious cover within the past 5 years ~~to include current application~~
~~Residential Type II Development~~	~~≤ 20% total site impervious cover; or~~ ~~≤ 1/3 ac disturbed area~~
Residential Type ~~II-III~~ Development (Type II-R)	≥ 1,000 SF of additional impervious cover; or~~and~~ ~~>~~ ≥ 20% total site impervious cover; or < ~~> 1/3 ac disturbed area; or~~ 100-feet of a FEMA designated floodplain or regulated stream shown in Appendix C ~~Development within 100 feet of a stream shown in Appendix CFEMA designated Special Flood Hazard Area~~

Table 2-2: Non-Residential Development Categories

Category	Criteria
Non-Residential Type I Development (Type I-C)	No Variances/Special Use Permits; and No work within easement; and > 100-feet of a FEMA designated floodplain or regulated stream shown in Appendix C; and < 400 SF of additional impervious cover
Non-Residential Type II Development (Type II-C)	≤ ~~<~~ 1,000 SF of additional impervious cover; and ≤ 30% total impervious cover; or ≤ 1/8 ac disturbed area
Non-Residential Type III Development (Type III-C)	> 30% total impervious cover; or > 1/8 ac disturbed area; or > 1,000 SF of additional impervious cover; or < 100-feet of a FEMA designated floodplain or regulated stream shown in Appendix C ~~100 feet of a stream shown in Appendix CDevelopment within FEMA designated Special Flood Hazard~~

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	~~Area~~

If any existing onsite or offsite stormwater infrastructure related to the development is known to be at or above design capacity, the development will be considered a Type II (Residential) and a Type III Development (Non-residential).
The submittal and drainage report requirements are outlined below. Submittal requirements are included on the applications available from the City.

2.1.1 PRELIMINARY DRAINAGE PLAN

A Preliminary Drainage Plan of the drainage system is required with preliminary ~~and final~~ plats. A Preliminary Drainage Plan may be required with a zoning, rezoning, special use permit or planned

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development plan applications. ~~The Preliminary Drainage Plan shall show locations of channels, storm sewers, detention structures, floodplain, floodway, and associated drainage easements at a minimum and shall provide sufficient calculations to verify sizing of facilities.~~

A Preliminary Drainage Plan shall at a minimum provide the following information:

~~The Preliminary Drainage Plan shall show locations of channels, storm sewers, detention structures, floodplain, floodway, and associated drainage easements at a minimum and shall provide sufficient calculations to verify sizing of facilities.~~

- Map existing and proposed flow paths.
- Show locations of channels, storm sewers, detention structures, floodplain, floodway, and associated drainage easements.
- Show how runoff will be conveyed safely through the site.
- Provide preliminary hydrologic calculations to show expected runoff volumes and peak flows.
- Provide preliminary hydraulic calculations to verify sizing of public facilities.
- Demonstrate that downstream conditions have been considered and will not be negatively impacted.
- A technical ~~narrative~~memo describing the site's overall stormwater management approach, including the intended conveyance, storage, and discharge strategies. The narrative shall identify existing drainage constraints, potential design challenges, and any additional analyses or studies required to confirm feasibility.

2.1.2 TYPE I DEVELOPMENT SUBMITTAL FOR RESIDENTIAL AND NON-RESIDENTIAL DEVELOPMENT

A Type I Development is for use with small-scale residential and non-residential improvements including remodeling, renovations, or minor additions. Criteria for Type I ~~1~~ application is illustrated in Section 2.~~-~~1. The submittal shall include all items on a complete application. Reference Checklist for Type I Residential & Non-Residential Development.

2.1.2.1 Type I Drainage Memo~~Report~~

A Type I Drainage Memo~~Report~~ shall be prepared by the property owner or its agent and provide, at a minimum, the following information:

- Applicant contact information (e.g. name, address, phone number, and email address)
- Site location map
- Description of the existing drainage patterns and description of proposed alterations; and
- Temporary erosion control plan
-

~~2.1.3 TYPE II DEVELOPMENT SUBMITTAL~~

~~A Type II Development is for use with standard residential and small-scale non-residential projects. The submittal shall include all items on a complete application.~~

~~*2.1.3.1 Type II Drainage Report*~~

~~A Type II Drainage Report shall be prepared, signed and sealed by a professional engineer licensed in the State of Texas, experienced in civil engineering, and having a thorough knowledge of hydraulic analysis and design.~~

~~The report shall contain, at a minimum, the following information:~~

- ~~Description of the existing drainage patterns and description of proposed alterations;~~

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- ~~Hydrologic calculations for each condition analyzed for the 2 , 10 , 25 , and 100 year storm events; and~~
- ~~Description and required calculations for hydrologic or hydraulic mitigation.~~

2.1.3 TYPE III DEVELOPMENT SUBMITTAL FOR RESIDENTIAL DEVELOPMENT

~~2.1.4~~

A Type II~~I~~ Development is for use with standard and large-scale residential ~~and standard non-residential~~ improvements. The submittal shall include all items on a complete application and shall be prepared by the agent. Reference Checklist for Type II Residential Development.

~~2.1.4.1~~2.1.3.1 *Type III Drainage and Water Quality Report*

A Type II~~I~~ Drainage and Water Quality Report shall be prepared, signed and sealed by a professional engineer licensed in the State of Texas, experienced in civil engineering. ~~, and having a thorough knowledge of hydraulic analysis and design.~~

The Type-II drainage report at the minimum should include verbiage regarding the ~~The~~ planning and design of drainage systems and should ensure that the project does not impact properties upstream and downstream of the subject property. ~~problems are not transferred from one location to another. Grading and other construction activities may not change the terrain in such a way to cause damage to public or private property from drainage or flood problems, increased runoff, or increased erosion or sediment movement.~~Construction activities such as on-site grading, should ensure the proposed improvements are constructed with minimal impacts to the existing grade and should avoid sediment movement and erosion. The proposed improvements should not exacerbate flooding downstream, and excess runoff shall be mitigated on site.

Property owners are responsible for resolving drainage concerns within developed lots. ~~Existing drainage between developed lots will remain the responsibility of the affected property owners.~~ The developer shall be responsible for pre-development and post-development flow conditions, with-in and adjacent to the subject property, including pre-existing drainage concerns. The developer shall protect/conserve natural flow courses and ensure unobstructed conveyance of storm water entering and leaving the site. ~~the conveyance of all storm drainage flowing through or abutting the subject property, including drainage directed to the property by prior development as well as that~~

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~~naturally flowing by reason of topography. Therefore,~~As part of a Type ~~-~~II submittal package, ~~-~~drainage computations shall be provided to verify no adverse impact upstream or downstream, which is further illustrated in Chapter 7 *Adverse Impact Analysis*.~~Section~~ .

Proposed improvements, such as on-site grading and/or addition or removal of impervious areas shall ensure that post-development flows are equal to or less than pre-development flows. ~~Proposed construction, platting or other development where the proposed activity or change in the land shall not result in post development discharge from the site exceeding discharge under pre-developed conditions (for new development) or existing conditions (for re-development).~~ Downstream capacity shall typically not be exceeded as a result of development. However, in cases where the capacity exceeds, the developer shall upgrade the current drainage infrastructure to ensure system has adequate capacity to handle the increase in flows. Additional drainage improvements are not required if the current drainage system ~~improvements have been provided for~~ has adequate capacity for the fully developed condition; as long as the assumptions made (for the proposed site) in the fully developed calculations, matches with the current ~~, which includes the~~ proposed development.

The report should contain, at a minimum, the following information:

- Description of project's geographic location, with respect to the watershed, streets, political boundaries, and other adjacent landmarks~~.~~.
  - At a minimum include a location exhibit and a USGS exhibit, indicating the site's location.
- ~~including indication of~~ FEMA defined floodplain ~~zone~~information adjacent to the site, including but not limited to: name of the flooding source, Flood Insurance Rate Map Panel Number, type of floodplain designation (Zone A, AE, X, ~~etc~~etc.), approximate date of the flood study, approximate date of topographic data
  - ~~-~~used for the flood study and flood mapping; distance from the FEMA Effective Floodplain, type of software used to develop the Effective flood models, methodology used to develop the Effective flood models, peak flows used in the models, etc. Additionally, show the site boundary overlaid on a FEMA firmette or FIRM panel~~.~~.
- If best available data such as topography, rainfall, and/or other significant Hydrologic or Hydraulic (H&H) parameters supersedes the data used in the Effective models; then the H&H models will need to be ~~updated~~updated, and the drainage report shall be updated with the resulting floodplain mapping. ~~and~~
- Edwards Aquifer zone designation. ~~A copy of the current FEMA floodplain should be provided with the project location indicated;~~
- Description of the existing drainage patterns and description of proposed ~~alterations;~~alterations.
- Description of all proposed improvements including buildings, roadways, and drainage ~~infrastructure;~~infrastructure.
- Drainage Area maps with a minimum of ~~1~~2 ~~-~~foot contours, with associated labels. Maps should also include ~~flowpath~~flow path delineations with associated ~~flowpath~~flow path classification. The map shall identify the point downstream of the site as "Point of Analysis 1" ~~and also~~and identify the zone of influence point based on the 10% drainage rule, as "Point of Analysis 2". Identify centroids of the sub-basins if needed for the analysis.
- Description and calculation of impervious cover, including a comparison between existing/pre-development and post-development ~~conditions;~~conditions.
- For larger watershed, use the best available aerial imagery to delineate and categorize developed areas to calculate an area-weighted average for each sub-basin.

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- Soil classification maps, with appropriate soil parameters such as curve numbers or similar.
- ~~Drainage area maps for all conditions analyzed;~~
- Provide a table showing the rainfall data used for the study, along with the source of the data
- Provide a hydrologic summary as input and output tables ~~and also~~and include ~~H~~hydrologic calculations for all conditions analyzed for the ~~2-, 10-~~5-, 25-, and 100-year storm ~~events;~~events.
- Hydraulic calculations for all existing and proposed natural and engineered conveyance systems shall be performed using a recent version of HEC-RAS; and
- Provide a hydraulic summary table with the flow, ~~wacr~~water surface elevation and velocity associated with each of the cross sections used in the hydraulic models and provide comparison tables between existing, proposed and any other relevant scenarios.
- Description and calculations for hydrologic or hydraulic mitigation.
- For FEMA applications, include all items required by FEMA, such as MT-2 forms, Annotated FIRM, Endangered Species Assessment (for CLOMRs), draft property owner notifications, as-built field survey (for LOMRs) ~~etc~~ etc.

2.1.4 TYPE II DEVELOPMENT SUBMITTAL FOR NON-RESIDENTIAL DEVELOPMENT

A Type II Development is for use with small-scale non-residential projects. The submittal shall include all items on a complete application. Reference Checklist for Type II Non-Residential Development.

2.1.4.1 Type II Drainage Report

A Type II Drainage Report shall be prepared, signed and sealed by a professional engineer licensed in the State of Texas, experienced in civil engineering, and having a thorough knowledge of hydraulic analysis and design.

The report shall contain, at a minimum, the following information:

- Description of the existing drainage patterns and description of proposed alterations;
- Hydrologic calculations for each condition analyzed for the 5-, 25-, and 100-year storm events; and
- Description and required calculations for hydrologic or hydraulic mitigation.

2.1.5 TYPE III DEVELOPMENT SUBMITTAL FOR NON-RESIDENTIAL DEVELOPMENT

A Type III Development is for use with large-scale residential and standard non-residential improvements. The submittal shall include all items on a complete application and shall be prepared by the agent. Reference Checklist for Type III Non-Residential Development.

2.1.5.1 Type III Drainage and Water Quality Report

A Type III Drainage and Water Quality Report shall be prepared, signed and sealed by a professional engineer licensed in the State of Texas, experienced in civil engineering, and having a thorough knowledge of hydraulic analysis and design.

The planning and design of drainage systems should ensure that problems are not transferred from one location to another. Grading and other construction activities may not change the terrain in such a way to cause damage to public or private property from drainage or flood problems, increased runoff, or increased erosion or sediment movement.

Existing drainage between developed lots will remain the responsibility of the affected property owners. The developer shall be responsible for the conveyance of all storm drainage flowing through or abutting the subject property, including drainage directed to the property by prior development as well as that naturally flowing by reason of topography. Therefore, drainage computations shall be provided to verify no adverse impact upstream or downstream.

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Proposed construction, platting or other development where the proposed activity or change in the land shall not result in post development discharge from the site exceeding discharge under pre-developed conditions (for new development) or existing conditions (for re-development). Downstream capacity shall not be exceeded as a result of development. Additional drainage improvements are not required if drainage improvements have been provided for the fully developed condition, which includes the proposed development.

The report should contain, at a minimum, the following information:

- Description of project location including indication of FEMA defined floodplain zone and Edwards Aquifer zone designation. A copy of the current FEMA floodplain should be provided with the project location indicated;
- Description of the existing drainage patterns and description of proposed alterations;
- Description of all proposed improvements including buildings, roadways, and drainage infrastructure;
- Description and calculation of impervious cover, including a comparison between existing/pre-development and post-development conditions;
- Drainage area maps for all conditions analyzed;
- Hydrologic calculations for all conditions analyzed for the 5-, 25-, and 100-year storm events;
- Hydraulic calculations for all existing and proposed conveyance systems; and
- Description and calculations for hydrologic or hydraulic mitigation.

2.1.6 IMPERVIOUS COVER

The table below outlines impervious cover restrictions for Building Rules and Drainage Mitigation. For water quality purposes, permeable concrete and pavers are treated as impervious surfaces when calculating Total Suspended Solids (TSS) load reduction and sizing Best Management Practices. Permeable concrete is permitted within the contributing zone; however, its use in the recharge zone is not currently authorized. For additional guidance on impervious cover limitations, consult the most recent edition of TCEQ Report Publication RG-348.

Residential development submittals must include two impervious cover tables: one addressing Building Rules and Drainage Mitigation titled "City of West Lake Hills Impervious Cover Table" and a second for water quality determination. The water quality table should be titled "Impervious Cover for Water Quality – Edwards Aquifer Recharge Zone" or "Impervious Cover for Water Quality – Edwards Aquifer Contributing Zone," as applicable.

Table 2-3: City of West Lake Hills Impervious Cover Table

Category	Criteria
100% Impervious	• Buildings and other Structures Parking areas, roads, streets, driveways, and compacted road base. • ~~Artificial turf~~ • Any other manmade areas of asphalt, impermeable concrete, compacted base material, pavers, or other impervious material. • Permeable concrete or pavement/pavers WITHOUT a *proper underdrain. • Infinity pools or pools with less than 6" of freeboard.
50% Impervious	• Wooden or composite decks with natural ground underneath and 0.25" gap width in between. • Crushed granite and/or gravel pathways installed over a Mirafi (140N) geotextile fabric with a minimum 2-inch sand bedding layer and with proper edging to prevent erosion during a rain event. ○ Cannot exceed 20% of front yard, maximum width of 3-foot. ○ Cannot exceed 20% of back yard.

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	• Artificial turf in the backyard only, WITH a *proper underdrain and limited to 25% of landscape area in the backyard.
0% Impervious	• Permeable concrete or pavement/pavers WITH a *proper underdrain. • Pools with at least 6" of freeboard on all sides • Manmade areas of loose rock or stone (2"-8" diameter, If the rock gradation exceeds 8", the impervious coverage will be 50%.) to be used as landscaping features that: o Do not have a compacted base; and o Are not used for the conveyance or storage of vehicles, machinery or equipment; and o Are sufficiently contained by edging to prevent erosion during a rain event. • 12" Masonry retaining walls, up to 200 linear feet allowed

*Proper underdrain: System designed to accommodate a 10-year storm.

Note: All other materials are subject to approval by City Staff/City Engineer.

2.2 Finished Floor Elevations

Buildings and structures shall have the lowest floor elevated to or above the base flood elevation as prescribed in the City Code Chapter 26. Finished grades shall be sloped to direct stormwater away from the structure. Developments adjacent to stormwater conveyance ~~structures~~ must be elevated above the 100-year water surface ~~flow~~ elevation (in the conveyance ~~infrastructure~~feature) to the same elevation that a development adjacent to a 100-year floodplain would be required to meet. Conveyance features are included in Appendix C.

2.3 Drainage Facility Design

Drainage patterns should be designed to prevent erosion, maintain filtration and recharge of local seeps and springs, and attenuate the harm of contaminants collected and transported by storm water. Overland sheet flow and natural drainage features and patterns shall be maintained to the greatest extent reasonably possible and the dispersion of runoff back to sheet flow shall be the primary objective of drainage design where possible, depending on volumes and velocities of runoff for the development, as opposed to concentrating flows in storm sewers and drainage ditches. The City requires preservation of the natural floodplains. The protection of existing trees and vegetation should be maximized during development of drainage plans.

Where new drainage improvements are required along the boundary of a site, the owner proposing development shall be responsible for designing and constructing all the required improvements at or before the time of development, including the dedication of all ROW or easements necessary to accommodate the improvements. Where the developer proposes to develop only a portion of the property, only the drainage improvements for the portion being developed shall be required to be installed, except as drainage improvements are necessary for proper drainage of the developed portion.

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All drainage facilities shall be designed to intercept and transport runoff from a 25-year storm event. The drainage system shall be designed to convey those flows greater than a 25-year storm event, up to and including a 100-year storm event within defined ROW or drainage easements.

Computations to support all drainage designs shall be submitted to the City for review in an easy to follow format. Onsite pre-development stormwater runoff computations shall be based upon conditions representing the existing land conditions with respect to soil type, percentage cover, and cover type as indicated by current aerial imagery and supporting documentation. Design of structures shall use fully developed conditions for the prescribed design storms based on the zoning and/or land use
Modeling and calculations shall be included in drainage report submittals to ensure the specified criteria are met for all drainage infrastructure improvements. Infrastructure that is within TxDOT ROW and requires dual permitting from both the City and TxDOT shall be designed in compliance with the more conservative requirements.

2.3.1 Stream Bank Erosion Hazard ~~S~~Drainage Easements ~~etbacks~~

Erosion hazard drainage ~~setback~~ determination is necessary for the banks of streams in which the natural channel is to be preserved. The purpose of the drainage ~~setbacks~~ is to reduce the amount of structural damage and stream degradation caused by the erosion of the bank. With the application of stream bank erosion hazard drainage ~~setbacks~~, an easement is dedicated to the City such that no structure can be located, constructed, or maintained in the area encompassing the erosion hazard drainage ~~setback~~. Stream bank erosion hazard drainage easement setback ~~setbacks are~~ are shown in Table 2-~~43~~.
The City allows for stream bank stabilization as an alternative to dedicating the erosion hazard ~~setback~~ zone as described in Section 7.4.2.

Table 2-~~43~~: Stream Bank Erosion Hazard Drainage Easement ~~Setbacks~~

Contributing Drainage Area (acres)	Drainage Easement ~~Setback~~ Distance from Stream Centerline (feet)
0 – 320	0
320 - 640	25
640 or more	50

2.3.2 Temporary Erosion Control

Temporary water quality BMPs shall be required when disturbance could result in erosion that could transport or cause accumulation of sedimentation in dedicated streets, alleys, any waterway, or other private properties during construction activities. Temporary and permanent erosion control requirements are provided in Chapter 7.

2.3.3 Drainage Easements and Right-of-Way

Public drainage easements shall include all natural and manmade drainage ways at least to the limits of the 100-year flood as indicated on the floodplain maps or as determined on the basis of the Drainage and Erosion Control Design Manual and drainage infrastructure necessary to serve public right-of-way. Drainage easements are required for detention and water quality facilities for subdivision and joint detention basins. Easement boundaries shall contain the berms, inlet and outlet structures, access ramps,

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permanent erosion control facilities, the 100-year water surface, and any additional area needed for access and maintenance. The minimum easement shall be at least 25 feet wide. All drainage easements across private property shall contain the necessary language to permit the required unobstructed water flow, require maintenance of vegetation by the property owner(s), and permit the necessary access by city officials for inspection and repairs.

2.3.4 FREEBOARD

Freeboard is the vertical distance between the design water surface and the elevation of the drainage facility, such as the top of channel, ditch, or detention pond. Freeboard is intended to provide a factor of safety and prevent the fluctuation of the water surface from overflowing the drainage facility. Freeboard requirements are shown in Table 2-45.

Table 2-54: Freeboard Requirements

Drainage Facility	Frequency	Minimum Freeboard
Street ROW	100-year	None
Channels and creek improvements	25-year	0.5 ft
Detention ponds (see note 1)	100-year	1.0 ft
Detention ponds (privately maintained for one single-family lot)	100-year	None
Bridges and culverts	25-year	See note 2

1 Detention ponds maintained by the City, regional detention ponds, or any other detention pond designed for detention of more than one privately maintained single-family lot.

2 Bridge and culverts shall be analyzed to verify any adverse hydraulic impacts are created.

2.4 Stormwater Mitigation

All proposed construction/development shall be designed such that the project does not cause an adverse impact to adjacent properties, drainage infrastructure, or roadways downstream of the project. Methods to verify no adverse impact include: ~~downstream drainage infrastructure improvements~~Mitigation through LID features, downstream drainage infrastructure improvements or detention.

Mitigation through detention, retention, or some other technique must be designed, constructed, and maintained to reduce the post-development peak flow discharge rates to below that of pre-development/existing peak flow discharge rates for the ~~two (2), ten (10),~~ five (5), twenty-five (25), and one- hundred (100) year design storms.

Demonstration that no mitigation is in the best interest of the watershed shall be accomplished by showing no adverse impact due to any increased runoff from the proposed development for the design storms. The property owner, or his/her designee, shall meet with the City to discuss impacts and mitigation options prior to commencing the project.

For stormwater mitigation, the following development conditions shall be analyzed with each adverse impact analysis:

A. Pre-Developed Conditions. Refers to the development condition within the watershed prior to any development. This should be used as the baseline for assessing the impact of all new development.
B. Existing Conditions. Refers to current development conditions in the watershed and on site. This shall be used as the baseline for assessing the impact of redevelopment projects.
C. Proposed Conditions. Refers to existing conditions modified with the proposed project development. This shall be used to assess adverse impact to other properties or drainage systems.
D. Post-Developed Conditions. Refers to the proposed condition modified with mitigation. This shall be used to verify the sizing and method of mitigation for the proposed development.
E. Ultimate Conditions. Refers to the development conditions in which all property within the watershed boundaries are developed per maximum zoning requirements.

2.5 Development in the Floodplain

~~2.6~~ It is the intent of the City Council that the requirements stated in the City Code Chapter 26 comply

with federal requirements pertaining to the FEMA authority concerning flood hazards and the USACE jurisdiction over waters of the United States. A permit shall be required for any lot located within 100 feet of a FEMA designated floodplain or for any portion of the lot located within 100 feet of a FEMA designated floodplain. No person, individual, partnership, firm, or corporation shall deepen, widen, fill, reclaim, reroute or change the course or location of any existing ditch, channel, stream or drainage way without first obtaining a permit from the City and any other applicable agencies having jurisdiction, such as FEMA or the USACE. The City may require preparation and submission of a FEMA study for a proposed development if there are concerns regarding storm drainage on the subject property or upstream or downstream from the subject property. The costs of such study, application, and/or permit, if required, shall be borne by the developer. The current FEMA floodplains and their associated flood sources can be found in Appendix C. Appendix C also includes water courses (conveyance features) that are not currently mapped by FEMA. Regulated streams (water courses that drain over 100 acres) will require a new flood study to establish the 100-year water surface elevations. ~~It is the intent of the City Council that the requirements stated in the City Code Chapter 26 comply with federal requirements pertaining to the FEMA authority concerning flood hazards and the USACE jurisdiction over waters of the United States.~~streamline ~~shown in Appendix C~~

~~No person, individual, partnership, firm, or corporation shall deepen, widen, fill, reclaim, reroute or change the course or location of any existing ditch, channel, stream or drainage way without first obtaining a permit from the City and any other applicable agencies having jurisdiction, such as FEMA or the USACE. The City may require preparation and submission of a FEMA study for a proposed development if there are concerns regarding storm drainage on the subject property or upstream or downstream from the subject property. The costs of such study, application, and/or permit, if required, shall be borne by the developer.~~ The current FEMA floodplains and their associated flood sources can be found in Appendix C. Appendix C also includes water courses (conveyance features) that are not currently mapped by FEMA and will need a new flood study to establish the 100-year water surface elevations. ~~-~~

~~2.7~~2.6 Permanent Water Quality Controls

Development and redevelopment located over the Edwards Aquifer regulatory zones shall comply with the latest TCEQ published rules and technical design guidance for the Edwards Aquifer in accordance with 30 TAC Chapter 213 (Edwards Aquifer Rules). Permanent water quality BMPs for development outside of the Edwards Aquifer regulated zones shall be designed to provide adequate treatment of the water quality volume in the City's jurisdiction as defined in Chapter 6.

~~2.8~~2.7 Maintenance of Drainage Facilities

All drainage facilities located in the street ROW except driveway culverts, shall be maintained by the appropriate jurisdiction. The property owner shall maintain all drainage facilities located on private property including driveway culverts. Authorized inspectors of the City shall have the right of entry on the land or premises where property owners are required to maintain drainage facilities or detention facilities, at reasonable times and after notifying the property owner, for the purpose of inspection of the maintenance.

~~2.8.1~~2.7.1 Maintenance Access

Access shall be provided to all ponds and channel maintained by the City, regional drainage facilities, or any other drainage facility designed for drainage of more than one privately maintained single-family lot as follows: ponds and channels shall provide a maintenance access with a width of at least 12 feet and have a vertical grade no steeper than 6H:1V. Access shall be provided within dedicated ROW or within the drainage easement and shall be clearly identified on plans.

Maintenance schedules and descriptions of maintenance practices for privately maintained single-family residential ponds and channels shall be provided within the plans or as a separate document. Adequate access shall be provided for the maintenance description provided.

CHAPTER 3 DETERMINATION OF STORM RUNOFF

3.1 General Requirements

The selection of the appropriate method for calculating runoff depends upon the size of the drainage area, time of concentration, and detention mitigation. Flows are to be analyzed for both existing and proposed conditions at all locations where runoff leaves a proposed project for the ~~2 , 10~~ 5-, 25-, and 100- year frequencies. Design discharges are to be calculated by either the Rational Method or the NRCS Unit Hydrograph Method.

The Rational Method is accepted as adequate for drainage areas totaling 200 acres or less with no detention or timing considerations. The National Resources Conservation Service hydrologic methods should be used for drainage areas larger than 200 acres but may also be used for drainage areas of any size. The method of analysis must remain consistent when drainage areas are combined and the method that applies to the largest combined drainage area should be used.

3.2 Design Rainfall

Rainfall, along with watershed characteristics, determines the storm runoff flows upon which storm drainage design is based.

3.2.1 RAINFALL INTENSITY DURATION FREQUENCY

Intensity-Duration-Frequency curves provide a summary of a site's rainfall characteristics by relating storm duration and storm frequency to rainfall intensity. The Intensity-Duration-Frequency curve parameters, included in Table 3-1, from the City of Austin DCM shall be used.

Table 3-1: Intensity Duration Frequency Parameters

Return Period	a	b	c
2	45.24	9.339	0.7399
10	61.25	8.352	0.7147
25	69.96	7.941	0.6954
100	77.31	6.832	.6524
500	77.48	4.967	0.5837

3.2.21 RAINFALL DEPTH DURATION FREQUENCY

The appropriate rainfall depths for calculations in the City are provided in Table 3-2. These are estimated from analysis performed for rainfall data available in the State of Texas. [1]

Table 3-2: Depth-Duration-Frequency (inches)

Duration	Return Period				
	2-year	10-year	25-year	100-year	500-year
5 min	0.53	0.80	0.98	1.28	1.68
15 min	1.06	1.60	1.96	2.54	3.34
30 min	1.49	2.25	2.75	3.54	4.69
1 hr	1.96	2.99	3.66	4.77	6.45
2 hr	2.42	3.82	4.81	6.57	9.27
3 hr	2.70	4.34	5.55	7.81	11.31
6 hr	3.17	5.21	6.78	9.79	14.48
12 hr	3.64	6.02	7.85	11.37	16.94
24 hr	4.14	6.84	8.90	12.80	19.05

3.3 The Rational Method

The Rational Method is appropriate for estimating peak discharge in basins that do not require detention or timing considerations. The method is based on the direct relationship between rainfall and runoff and is given by the following relationship (Equation 3-1):

$$Q=k(ciA) \quad \text{(Equation 3-1)}$$

Where:

Q = peak runoff (cfs)
k = Antecedent Precipitation Coefficient (Table 3-3)
c = Runoff Coefficient (Table 3-4)
i = Average rainfall intensity (in/hr)
A= Drainage area (ac)

Table 3-3: Antecedent Precipitation Coefficient (k)

Frequency	k
2 year	1.00
10 year	1.00
25 year	1.10
100 year	1.25

The Rational Method equation is based on the following assumptions:

- Rainfall intensity is constant over the time it takes to drain the watershed (time of concentration)
- The runoff coefficient remains constant during the time of concentration
- The watershed area does not change
- The minimum time of concentration is not less than 10 minutes and does not exceed 3-hours

3.3.1 Runoff Coefficient

Suggested runoff coefficients (c) with respect to specific surface types are given in Table 3-4. The runoff coefficients include an antecedent precipitation factor to reflect the additional runoff that results from saturated ground conditions with less frequent recurrence intervals. The City must approve assumptions for fully developed conditions where maximum allowable impervious cover is not defined by City Code. Runoff coefficients for developed conditions should be based on composite values given by Equation 3-2.

$$c = Ic_i + (1 - I)c_p \quad \text{(Equation 3-2)}$$

Where:

c = Composite runoff coefficient
I = Impervious cover (%)
c_i = Runoff coefficient for impervious cover
c_p = Runoff coefficient for pervious cover

Table 3-4: Runoff Coefficient (c)

Surface (Developed)			c	Area (Undeveloped)	c
Pavement				Cultivated	
Asphaltic			0.81	Flat, 0-2%	0.36
Concrete			0.83	Average, 2-7%	0.41
Grass (Lawn, Parks)				Steep, over 7%	0.44
Condition	Poor	Fair	Good	Pasture/Range	
Flat, 0-2%	0.37	0.30	0.25	Flat, 0-2%	0.30
Average, 2-7%	0.43	0.38	0.35	Average, 2-7%	0.38
Steep, over 7%	0.45	0.42	0.40	Steep, over 7%	0.42
"Poor" consists of less than 50 percent coverage. "Fair" consists of between 50 and 75 percent coverage. "Good" consists of greater than 75 percent coverage.				Forest/Woodlands	
				Flat, 0-2%	0.28
				Average, 2-7%	0.36
				Steep, over 7%	0.41

3.3.2 TIME OF CONCENTRATION

The time of concentration is the time for surface runoff to flow from the most hydraulically remote point in the drainage basin to the drainage point of interest. The most hydraulically remote point refers to the route requiring the longest drainage travel time and not necessarily the greatest linear distance. Furthermore, the most hydraulically remote point must be taken from a location that best represents the majority of the contributing area.

The preferred procedure for estimating time of concentration is the Natural Resources Conservation Services (NRCS) method as described in Technical Release 55 [2]. This method is outlined below. The time of concentration to any point in a storm drainage system is the sum of the sheet flow (overland), the shallow concentrated flow, and the channel flow, which may include storm drains. Note that there may be multiple shallow concentrated and channel segments depending on the nature of the flow path. The minimum time of concentration for any drainage area shall be 10 minutes.

Sheet Flow

Sheet flow is shallow flow over land surfaces, which usually occurs in the headwaters of streams. The engineer should realize that sheet flow occurs for only very short distances, especially in urbanized conditions. Sheet flow for both natural (undeveloped) and developed conditions should be limited to a maximum of 100 feet. Sheet flow for developed conditions should be based on the actual pavement or grass conditions for areas that are already developed and should be representative of the anticipated land use within the headwater area in the case of currently undeveloped areas. In a typical residential subdivision, sheet flow may be the distance from one end of the lot to the other or from the house to the edge of the lot. In some heavily urbanized drainage areas, sheet flow may not exist in the headwater area. The NRCS method employs Equation 3-3, which is a modified form kinematic wave equation, for the calculation of the sheet flow travel time.

$$T_t = \frac{0.42(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$$ (Equation 3

Where:

T_t = Travel time (min)
L = Length of the reach (ft)
n = Manning's coefficient (Table 3-5)
P_2 = 2-year, 24-hour rainfall (in) (Table 3-2)

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s = Slope of the ground (ft/ft)

Overland flow

After a maximum of approximately 100 feet, sheet flow usually becomes shallow concentrated flow collecting in swales, small rills, and gullies. Shallow concentrated flow is assumed not to have a well-defined channel and has flow depths of 0.1 to 0.5 feet. The travel time for shallow concentrated flow can be computed by Equation 3-4.

$$T_t = \frac{Ln}{(60s^{0.5})} \quad \text{(Equation 3-3)}$$

Where:

T_t = Travel time (min)
L = Length of the reach (ft)
n = Manning's coefficient (Table 3-5)
s = Slope of the ground (ft/ft)

Table 3-5: Manning's Coefficients for Overland Flow

Surface Description	Manning's Coefficient (n)
Concrete (rough or smoothed finish)	0.015
Asphalt	0.016
Fallow (no residue)	0.050
Cultivated Soils:	
Residue Cover ≤ 20%	0.060
Residue Cover > 20%	0.170
Grass:	
Short-grass prairie	0.150
Dense grasses	0.240
Bermuda Grass	0.410
Range (natural)	0.130
Woods:	
Light Underbrush	0.400
Dense Underbrush	0.800
Source: City of Austin Drainage Criteria Manual [3]	

Channel flow

The velocity in an open channel or a storm drain not flowing full can be determined by using Manning's Equation. Channel velocities can also be determined by using backwater profiles. For open channel flow, average flow velocity is usually determined by assuming a bank-full condition. The channel flow component of the time of concentration may need to be divided into multiple segments in order to represent significant changes in channel characteristics. The details of using Manning's Equation and selecting Manning's coefficient for channels can be obtained from HEC-22. Manning's coefficients for channel flow are located in Table 4-3. For conveyance within storm drains, Manning's coefficients are included in Table 3-6.

Table 3-6: Manning's Coefficients for Closed Conduits

Material	Manning's Coefficient (n)
Asbestos-cement pipe	0.011-0.015
Concrete pipe	0.011-0.015
Concrete box	0.012-0.015
Corrugated metal pipe	0.018-0.026
Polyvinyl chloride (PVC) pipe	0.009-0.011
Source: TxDOT Hydraulic Design Manual [4]	

3.3.3 RAINFALL INTENSITY

Rainfall intensity (i) is the average rainfall rate in inches per hour, and is selected based on design rainfall duration and design frequency of occurrence. The design duration is equal to the time of concentration for the drainage area under consideration. The design frequency of occurrence is a statistical variable that is established by design standards or chosen by the engineer as a design parameter.

The rainfall intensity used in the rational method can be calculated the value of rainfall intensity from the parameters, Table 3-1, and Equation 3-6 with the known Tc value for the entire drainage area.

$$i = \frac{a}{(T_c+b)^c} \qquad \text{(Equation 3-6)}$$

3.4 NRCS Unit Hydrograph

The preferred unit hydrograph in general is the NRCS Dimensionless Unit Hydrograph. The runoff curve number used in calculating the existing/pre-development condition and the post-development condition shall be documented. A fully developed drainage area shall be assumed for the post-development condition. Average antecedent moisture conditions II (AMC II) shall be assumed.

3.4.1 CURVE NUMBER

Rainfall infiltration losses depend primarily on soil characteristics and land use (surface cover). The NRCS method uses a combination of soil conditions and land use to assign runoff Curve Numbers. NRCS curve numbers are to be selected from Table 3-7. Note that Curve Numbers are whole numbers. For a watershed that has variability in land cover and soil type, a composite Curve Number is calculated and weighted by area.

Table 3-7: Runoff Curve Numbers

Cover Description	Curve Numbers for Hydrologic Soil Group			
	A	B	C	D
Developed Areas				
Streets and Roads	98	98	98	98
Commercial and business (85% IC)	89	92	94	95
Residential: 1/8 acre or less (65% IC)	77	85	90	92
Residential: 1/4 acre (38% IC)	61	75	83	87
Residential: 1/3 acre (30% IC)	57	72	81	86
Residential: 1/2 acre (25% IC)	54	70	80	85
Residential: 1 acre (20% IC)	51	68	79	84
Residential: 2 acre (12% IC)	46	65	77	82
Open Space: Poor Condition	68	79	86	89
Open Space: Fair Condition	49	69	79	84
Open Space: Good Condition	39	61	74	80
Undeveloped Areas				
Pasture, grass land or range: Poor Condition	68	79	86	89
Pasture, grass land or range: Fair Condition	49	69	79	84
Pasture, grass land or range: Good Condition	39	61	74	80
Meadow – continuous grass	30	58	71	78
Brush: Poor Condition	48	67	77	83
Brush: Fair Condition	35	56	70	77
Brush: Good Condition	30	48	65	73
Woods-grass combination: Poor Condition	57	73	82	86
Woods-grass combination: Fair Condition	43	65	76	82
Woods-grass combination: Good Condition	32	58	72	79
Woods: Poor Condition	45	66	77	83
Woods: Fair Condition	36	60	73	79
Woods: Good Condition	30	55	70	77
"Poor" consists of less than 50 percent coverage. "Fair" consists of between 50 and 75 percent coverage. "Good" consists of greater than 75 percent coverage.				

Curve numbers can be reduced by either using a climatic adjustment as described in the 2016 TxDOT Hydraulic Design Manual (HDM) [4] or calibrating to historical storms. If curve numbers are calibrated from historical storms, the Engineer must provide documented data for rainfall, stream flow data, or detention pond stage storage data used to determine the historical curve numbers.

3.4.~~1~~2 LAG TIME

Time of concentration shall be computed using the same techniques as for the Rational Method. The lag time, defined as the time between the center of mass of excess rainfall to the runoff peak, is typically used in the Hydrologic Modeling System (HEC-HMS) implementation of the NRCS methodology. The lag time can be estimated with Equation 3-7.

$$T_l = 0.6T_c \qquad \text{(Equation 3-7)}$$

The NRCS Unit Hydrograph shall be analyzed using 24-hour rainfall depths provided in Table 3-2. The 24-hour rainfall depths are to be distributed temporally with the NRCS Type III rainfall distribution.

CHAPTER 4 DESIGN OF DRAINAGE INFRASTRUCTURE

4.1 General Requirements

The following sections apply to the design of improvements within existing or proposed public ROW to minimize the interference to traffic and the likelihood of stormwater damage to surrounding property.

4.2 Street Flow

Interference to traffic is regulated by design limits of the spread of water into traffic lanes. Runoff shall not enter private property from a street except in recorded drainage easements or ROW, or in historic watercourses where easements or ROW have not been obtained.

Driveways should be constructed to allow the runoff from a 25-year design storm to pass under the driveway in a culvert (18 inches minimum or equivalent) or over the driveway on a concrete apron where conveyance is parallel to the roadway. Concrete aprons or box culverts are preferred in areas of heavy sediment transport.

The side slope of a ditch or swale on the side adjacent to City roads shall be no steeper than 4H:1V. Roadways under TxDOT jurisdiction shall be designed in accordance with TxDOT requirements.

4.2.1 Flow at Intersections

As the stormwater flow approaches a street or tee intersection, an inlet is required. The inlet cannot be placed inside the curb return. Valley gutters can be useful in diminishing the deterioration of pavements, particularly at intersections where flows tend to concentrate. At the intersection of two (2) thoroughfare or arterial streets, a valley gutter cannot be used. At the intersection of two (2) collector streets or local streets, the valley gutter may be used. At an intersection of two (2) different types of streets, a valley gutter may be used across the smaller street only.

4.2.2 Permissible Spread of Water

The flow of water in gutters of typical streets during the 25-year storm shall be contained below the top of curb and shall maintain the clear width requirements listed in Table 4-1. The flow of water shall be limited to a maximum of 6-inches above the top of crown during the 100-year storm event and must be contained within the defined ROW and easements. These clear widths at the crown of the roadway or at the high point on a divided roadway are necessary to provide access for vehicles in the event of an emergency.

Table 4-1: Water Spread Limits for Roadways

Street Classification	25-year permissible water spread
Thoroughfare	All lanes must remain open
Arterial Street	One 11-foot traffic lane must remain open in each direction
Collector Streets	Clear width of 11-feet must remain open
Minor Streets	Maximum depth of 6-inches

4.2.3 Street Flow Calculations

Evaluation of street flow is based upon open channel hydraulics theory, with the Manning's Equation modified to allow direct solution, based on the street cross section. The methodology included in the *Hydraulic Engineering Circular 22: Urban Drainage Design Manual (HEC 22)* [5] should be followed for determining proposed roadway improvements.

4.3 Inlet Design

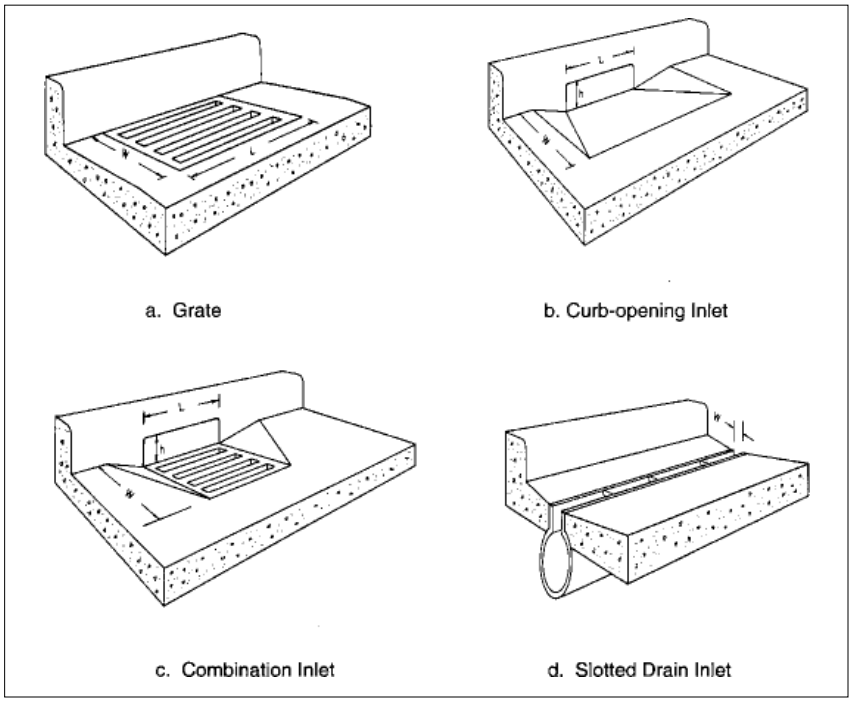
Inlets shall be located as necessary to remove the flow based on the 25-year storm and accommodate ponding widths in streets as defined in Table 4-1. The hydraulic efficiency of storm drain inlets varies with the amount of gutter flow, street grade, street crown, and the geometry of the inlet opening. No lowering of the standard height of street crown shall be allowed for the purposes of obtaining additional hydraulic capacity.

4.3.1 Inlet Types and Descriptions

Storm drain inlets are designed to collect and convey runoff to a storm drainage system. They are typically located at the street curb, paved medians, and in roadside and median ditches. The inlets are commonly divided into four categories:

a. Grate inlets
b. Curb-opening inlets
c. Combination inlets
d. Slotted drain inlets

Figure 4-1: Types of Storm Drainage Inlets



Source: HEC 22

4.3.1.1 Grate Inlets

Grate inlets are installed in the area of the roadway where the water is flowing and perform reasonably over a wide range of gutter grades. Some of the disadvantages are they lose capacity with increase in grade, may clog by debris, and pose a hazard to bicycle and wheelchair traffic. Therefore, these inlets must be configured to be safe for wheelchairs and bicycles.

4.3.1.2 Curb-Opening Inlets

Curb-opening inlets function effectively on flatter slopes or sags and where there is potential for a significant amount of debris in the gutter flow. They lose interception capacity as the gutter grade increases and therefore are recommended to be placed in grades no steeper than 3%.

4.3.1.3 Combination Inlets

Combination inlets have a high runoff interception capacity as they incorporate both the grate inlet and the curb opening inlet. If the curb opening is placed upstream of the grate inlet, it will act as a "sweeper" by intercepting floating debris in the early phase of a storm.

4.3.1.4 Slotted Drain Inlets

Linear inlets, slotted drains and trench drains, are placed in areas where runoff needs be intercepted over a wide section with low flows. The main disadvantage is they are very vulnerable to clogging from sediments and debris. Slotted drains may only be used with City permission. Trench drains are acceptable for use on driveways and low volume areas.

4.3.2 Inlet Capacity Calculations

The inlet capacity calculations shall be performed using the methodology contained in the TxDOT HDM.

4.3.2.1 Inlets On-Grade

The interception capacity of inlets on grade is dependent on the cross slope, longitudinal slope, total gutter flow, and pavement. The interception capacity of all inlet configurations increases with increasing flow rates, and inlet efficiency generally decreases with increasing flow rates. Designs must account for bypass flow.

4.3.2.2 Inlets in Sag Configurations

Inlets in a sag locations operate as weirs under low head conditions and as orifices at greater depths. Orifice flow begins at depths dependent on the grate size, the curb opening height, or the slot width of the inlet. At depths between those at which weir flow prevails and those at which orifice flow prevails, flow is in a transition stage. At these depths, control is ill defined and flow may fluctuate between weir and orifice control.

The efficiency of inlets in passing debris is critical in sag locations because all runoff which enters the sag must be passed through the inlet. Total or partial clogging of inlets in these locations can result in hazardous ponded conditions. Grate inlets alone are not recommended for use in sag locations because of the tendencies of grates to become clogged. Combination inlets or curb opening inlets are recommended for use in these locations.

4.4 Storm Drain Systems

The combined street system, including ditches, swales, and channels, directs flow into a collection structure, such as an inlet or grate, and deposits flow into the storm drain system. The objective is to provide safe passage of vehicle traffic by collecting stormwater from roadway surfaces and safely conveying it to an adequate receiving body.

4.4.1 General Requirements

The following shall be considered during the design of storm drain systems.

a. Storm drain pipe shall be reinforced concrete pipe (AASHTO M170 Class III). Corrugated metal pipe or plastic pipe shall not be permitted for storm drain systems in the public ROW.
b. Manholes or junction boxes must be used at all pipe size changes on trunk lines. For all pipe junctions, other than manholes and junction boxes, manufactured wye connections should be used, and the angle of intersection shall not be greater than 45 degrees. Laterals shall be connected to trunk lines using manholes or manufactured wye connections. Vertical curves in the conduit will not be permitted, and horizontal curves must meet manufacturer's requirements for offsetting of the joints.
c. The maximum manhole and junction box spacing for storm drain systems are shown in Table 4-2. Manholes or junction boxes shall also be placed at pick up points having three or more laterals; vertical alignment changes; and future collection points. The requirement for manholes may be waived if the pipe size allows direct access into the pipe by maintenance personnel and equipment.
d. The cover over the crown of circular pipe should be at least three feet and should be based on the type of pipe used, the expected loads, and the supporting strength of the pipe. Box sections should normally have a minimum of one foot of cover; however, box sections may be designed for direct traffic in special situations with approval.
e. Grates for drop inlets should be designed to facilitate removal for maintenance, but minimize vandalism. Design shall consider traffic loading, bicycle and pedestrian safety, and a means to secure the grate.
f. At no time shall bypass flow exceed the water spread limits for roadways as defined by Table 4-1. Inlets shall be located to prevent water convergence and/or excessive flows through intersections.
g. For arterial or collector streets with super-elevated sections, no more than 3 cubic feet per second of the 25-year flow will be allowed to cross from the higher elevation to the lower elevation.

Table 4-2: Maximum Manhole Spacing

Pipe Diameter (in)	Max. Spacing (ft)
24	400
27-39	800
42-60	1,000
Larger than 60	1,200

4.4.2 Design Criteria

The capacity of a storm drain network has several limiting factors, including the total incoming flow dependent on the severity of the storm, size, shape, and material of the network pipes, flow rate, and velocity, geometric changes causing energy losses, and exiting structure. To design a storm drain system, the following criteria will be used to create a system with the necessary capacity.

a. The design storm shall be the 25-year storm with provisions made for the 100-year storm. Design of storm drain systems shall follow the TxDOT HDM, utilizing Manning's Equation for closed conduits and step backwater methodology for open channels. For Manning's equation, the minimum roughness coefficient for a concrete storm pipe is 0.013.
b. Conduits within the storm drain system shall have a minimum velocity of 2 feet per second. This requirement shall protect the ability of the system to convey the design storm by limiting or preventing the accumulation of sediment within closed conduits.

c. Maximum conduit velocities for trunk lines and inlet laterals longer than 30 feet are 12 feet per second. A maximum velocity is required to prevent the erosion of the storm pipe material over time. The exiting velocity of a given storm drain system must be below the design velocity for the receiving channel or outfall structure. Erosion control measures are required for all outfalls into natural channels.
d. All energy losses, including entrance and exit losses, expansion losses, manhole and bend losses, junction losses, and minor head losses at points of turbulence, shall be included in calculations to determine the hydraulic gradient.
e. Storm lines discharging into open channels shall have flowlines higher or equal to those of the receiving open channel. The storm system is not allowed to be at sump with the channel.
f. Slope, along with larger diameter pipes located downstream, must be utilized such that the velocity of flow features a gradual increase, or at a minimum prevent large decreases at changes in geometry, including bends and inlets, to prevent sedimentation from occurring.
g. At connections of pipes with differing diameters, the pipe crowns (soffits) shall be matched, instead of matching the flow lines.

4.4.3 Calculation of the Hydraulic Grade Line

The hydraulic grade line (HGL) for a conduit system must be calculated with the inclusion of all energy losses and depicted in the system profile drawing. The hydraulic grade line must be computed and drawn for both the 25-year design storm and the 100-year storm. The methodology for calculating the hydraulic grade line is located in HEC 22.

4.4.3.1 Tailwater Conditions

The capacity of a system is dependent on the tailwater conditions, thus the tailwater conditions must be determined prior to designing storm drain systems. When calculating the hydraulic performance of a storm drain system discharging into an existing watercourse, tailwater elevation must be determined by the design engineer. However, the tailwater elevation must be greater than the existing water surface of the receiving channel and the minimum outlet water surface.

The design engineer must also determine the maximum outlet velocities of the storm drain network and include the "Normal Depth" outfall analysis. As a part of the analysis, the design engineer must solve the downstream boundary condition using Manning's equation for Normal Depth.

4.4.3.2 Head Loss

To design a conduit system, the head loss within the system must be computed. The head loss is the combined friction losses, minor losses, and junction losses for the system. The procedure for calculating head loss is included in the TxDOT HDM.

4.5 Open Channels

The general classifications for open channels are natural channels, which include all watercourses that have been carved by nature through erosion; and engineered channels, which are constructed or existing channels that have been significantly altered by human effort. No person shall place or cause to be placed any obstruction of any kind in any watercourse within the City and its ETJ. The owner of any property within the City, through which any watercourse may pass, shall keep the watercourse free from obstruction.

4.5.1 Design Criteria

The parameters that need to be considered in channel design include: flow capacity, permissible velocity, side slope, and freeboard.

- Flow Capacity: All channels shall be designed to convey the 100-year storm event with freeboard in accordance with Table 2-4;
- Permissible Velocity: The minimum permissible velocity is 2 fps for the 25-year storm. The maximum permissible velocity for the 100-year storm must be non-erosive; and
- Side Slopes: The channel slopes shall be 3H:1V or flatter.

4.5.2 ROUGHNESS COEFFICIENTS

The roughness coefficients describe the degree of resistance that natural or artificial channels have to flow conveyance. The recommended roughness coefficient values for use in open channel hydraulic analyses are presented in Table 4-3.

Table 4-3: Roughness Coefficients

Type of Channel and Description	Minimum	Normal	Maximum
LINED OR BUILT-UP CHANNELS			
Concrete-lined	0.012		0.025
Concrete rubble	0.017		0.030
UNLINED CHANNELS			
Earth, straight, and uniform	0.017		0.025
Winding and sluggish	0.022		0.030
Rocky beds, weeds on bank	0.025		0.040
Earth bottom, rubble sides	0.028		0.035
Rock cuts	0.025		0.045
NATURAL STREAMS			
Minor Streams (top width at flood stage<100 ft)			
Streams on plain			
clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
clean and straight with more stones and weeds	0.030	0.035	0.040
clean, winding, some pools and shoals	0.033	0.040	0.045
clean and winding but some weeds and stones	0.035	0.045	0.050
same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
clean, winding, some pools and shoals with more stones	0.045	0.050	0.060
sluggish reaches, weedy, deep pools	0.050	0.070	0.080
very weedy reaches or floodways with heavy underbrush	0.075	0.100	0.150
Floodplains			
Pasture, no brush			
short grass	0.025	0.030	0.035
high grass	0.030	0.035	0.050
Brush			
scattered brush, heavy weeds	0.035	0.050	0.070
light brush and trees, in winter	0.035	0.050	0.060
light brush and trees, in summer	0.040	0.060	0.080
medium to dense brush, in winter	0.045	0.070	0.110
medium to dense brush, in summer	0.070	0.100	0.160
Trees			
dense willows, summer, straight	0.110	0.150	0.200
cleared land with tree stumps, no sprouts	0.030	0.040	0.050
cleared land with tree stumps with heavy growth of sprouts	0.050	0.060	0.080

Type of Channel and Description	Minimum	Normal	Maximum
heavy stand of timber and little undergrowth	0.080	0.100	0.120
same as above with flood stage reaching branches	0.100	0.120	0.160
Major Streams (top width at flood stage>100 ft)			
Regular section with no boulders or brush	0.025		0.060
Irregular and rough section	0.035		0.100

4.5.3 CHANNEL ANALYSIS

For the analysis and design of open channels the depth and velocity of flow are necessary. For the hydraulic analysis of open channels, the following two methods are commonly used:

- Slope Conveyance Method
- Standard Step Backwater Method

The above two methods of analysis are included in the TxDOT Hydraulic Design Manual.

4.5.4 SUPERCRITICAL FLOW

The Froude Number, Equation 4-1, provides a relationship between flow velocity and the hydraulic depth of flow, and gravitational action and shall be calculated for all channel improvement designs. Subcritical flow conditions occur when the Froude Number is less than 1.0 and supercritical flow conditions exist in lined channels when the Froude Number exceeds 1.0.

If the normal depth in a channel is supercritical, its alternate depth is a deeper subcritical depth. Obstructions that may enter a stream during a storm event may cause supercritical flows to experience a hydraulic jump and become subcritical flows. When it is calculated that supercritical conditions could occur for the design storm, the depth of the channel must be at least the alternate depth plus the required freeboard. Adequate protection of the channel must be provided to protect against supercritical flow.

Subcritical flow conditions are recommended for all channel designs, as supercritical flow tends to have high velocities and high potential for channel erosion. Supercritical flow conditions will not be allowed in channels with a vegetative lining. Subcritical flow conditions may be achieved by using energy dissipators in areas where the existing topography will not allow subcritical flow conditions to occur naturally. In all cases, the channel improvements shall be designed to avoid the unstable transitional flow conditions that occur when the Froude Number is between 0.9 and 1.1.

$$F = \frac{v}{\sqrt{gD}} \qquad \text{Equation 4-1}$$

Where:

F=Froude number (dimensionless)
v=average velocity (ft/s)
g=gravitational acceleration (32.3 ft/s^2)
D=hydraulic depth (ft)

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4.5.5 SHEAR STRESS

Shear stress represents the component of stress that acts in the direction of the flow. Shear stress shall be computed for all open channels and adequate protection shall be provided based on the tractive force method described in HEC 15 [6] and the permissible shear stresses reported in the TxDOT HDM.

The shear stress at normal depth should be computed. The channel lining selected, Table 4-4, will determine the permissible shear stress, Table 4-5. If the computed shear stress is less than the permissible

stress, the lining is adequate. Otherwise, consider the following options: choose a more resistant lining, decrease channel slope, decrease slope in combination with drop structures, or increase channel width or flatten side slopes. Non-native plants are prohibited for use within channels.

Table 4-4: Retardation Class for Lining Materials

Retardance Class	Cover	Condition
A	Weeping lovegrass	Excellent stand, tall (average 30 in. or 760 mm)
B	Native grass mixture little bluestem, bluestem, blue gamma, other short and long stem midwest grasses	Good stand, uncut
	Weeping lovegrass	Good Stand, tall (average 24 in. or 610 mm)
	Lespedeza sericea	Good stand, not woody, tall (average 19 in. or 480 mm)
	Alfalfa	Good stand, uncut (average 11 in or 280 mm)
	Weeping lovegrass	Good stand, uncut (average 13 in. or 330 mm)
	Blue gamma	Good stand, uncut (average 13 in. or 330 mm)
C	Crabgrass	Fair stand, uncut (10-to-48 in. or 55-to-1220 mm)
	Bermuda grass	Good stand, mowed (average 6 in. or 150 mm)
	Common lespedeza	Good stand, uncut (average 11 in. or 280 mm)
	Grass-legume mixture: summer (orchard grass redtop, Italian ryegrass, and common lespedeza)	Good stand, uncut (6-8 in. or 150-200 mm)
	Centipedegrass	Very dense cover (average 6 in. or 150 mm)
	Kentucky bluegrass	Good stand, headed (6-12 in. or 150-305 mm)
D	Bermuda grass	Good stand, cut to 2.5 in. or 65 mm
	Common lespedeza	Excellent stand, uncut (average 4.5 in. or 115 mm)
	Buffalo grass	Good stand, uncut (3-6 in. or 75-150 mm)
	Grass-legume mixture: fall, spring (orchard grass Italian ryegrass, and common lespedeza	Good Stand, uncut (4-5 in. or 100-125 mm)
	Lespedeza sericea	After cutting to 2 in. or 50 mm (very good before cutting)
E	Bermuda grass	Good stand, cut to 1.5 in. or 40 mm
	Bermuda grass	Burned stubble
Source: TxDOT HDM		

Table 4-5: Permissible Shear Stress for various linings

Protective Cover	(lb/sf)
Retardance Class A Vegetation	3.70
Retardance Class B Vegetation	2.10
Retardance Class C Vegetation	1.00
Retardance Class D Vegetation	0.60
Retardance Class E Vegetation	0.35
Woven Paper	0.15
Jute Net	0.45
Single Fiberglass	0.60
Double Fiberglass	0.85
Straw W/Net	1.45
Curled Wood Mat	1.55
Synthetic Mat	2.00
Gravel, D50 = 1 in. or 25 mm	0.40
Gravel, D50 = 2 in. or 50 mm	0.80
Rock, D50 = 6 in. or 150 mm	2.50
Rock, D50 = 12 in. or 300 mm	5.00
6-in. or 50-mm Gabions	35.00
4-in. or 100-mm Geoweb	10.00
Soil Cement (8% cement)	>45
Dycel w/out Grass	>7
Petraflex w/out Grass	>32
Armorflex w/out Grass	12-20
Erikamat w/3-in or 75-mm Asphalt	13-16
Erikamat w/1-in. or 25 mm Asphalt	<5
Armorflex Class 30 with longitudinal and lateral	>34
Dycel 100, longitudinal cables, cells filled with mortar	<12
Concrete construction blocks, granular filter	>20
Wedge-shaped blocks with drainage slot	>25
Source: TxDOT HDM	

4.5.6 ENERGY DISSIPATORS

Energy dissipators are commonly used for culverts and channels in order to prevent erosion problems by dissipating the flow energy at specific locations prior to discharging downstream. Design methodology for these structures is presented in HEC-14 [7].

The energy dissipators fall under different categories including:

- Internal Dissipators
- Stilling Basins
- Streambed Level Dissipators
- Riprap Basins and Aprons
- Drop Structures
- Stilling Wells

4.6 Bridges and Culverts

A bridge is defined as a structure, including supports, erected over a depression or having a roadway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between faces of abutments, spring lines of arches, or extreme ends of openings for multiple box culverts. Culverts convey surface water through a roadway embankment away from the roadway ROW or into a channel along the ROW.

4.6.1 General Requirements

All proposed bridges and culverts must meet the following criteria:

a. All culverts shall be a minimum size of a 18-inch circular pipe or equivalent for alternate shapes. Reinforced concrete shall be the material of choice. Other materials must be approved by the City.
b. Allowance shall be made for conveyance of the 100-year runoff across the road and into the downstream channel without damage to the road or adjacent property.
c. Temporary crossings shall be designed to safely pass the 2-year design storm runoff.
d. The backwater created by a culvert or bridge during the 100-year design storm runoff shall not cause damage to public or private property.
e. Culvert outlets shall be designed to minimize damage caused by erosion.
f. Culverts and bridges shall be aligned with natural drainage ways in grade and direction whenever practical. Culverts shall have a minimum design storm velocity of 2.5 feet per second to reduce sediment accumulation.
g. Larger culvert sizes, bridges, box culverts, and/or smooth-walled pipes are recommended for crossings where heavy debris or sediment accumulations are anticipated. Trash racks may be required.
h. All headwalls shall be constructed of reinforced concrete.

4.6.2 Bridge Design Criteria

Additional design criteria from that stated above will be on a case-by case basis as determined by the City Engineer.

4.6.3 Culvert Design Criteria

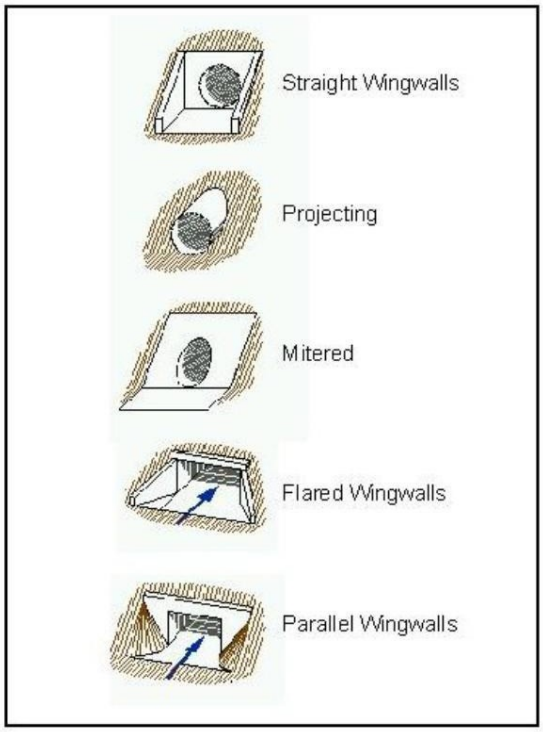
All proposed culverts shall be designed to meet the following criteria:

a. Headwalls and necessary erosion protection shall be provided at all culverts and shall comply with TxDOT standard details. All culverts and bridges are to be analyzed at both the design flow and 100-year check flow.
b. Alignment, location, and grade of proposed culverts must be consistent with planned development of the drainage system for that watershed. In the event the particular watershed or waterway is not covered by a planned storm drainage system, the designer should proceed with the design from the nearest downstream control and design the proposed drainage system improvements anticipating future system expansion due to fully developed watershed conditions.
c. Wingwalls, if used, may be either straight parallel, flared, or tapered. Approach and discharge aprons shall be provided for all culvert headwall designs. Precast headwalls and end walls may be used if all other criteria are satisfied.

4.6.4 CULVERT END TREATMENTS

End Treatment of a culvert is to create safer conditions surrounding the culvert without interfering with the hydraulics of the culvert design. There are a multitude of end treatments available for culverts. The TxDOT Bridge Division maintains standard details of culvert end treatments. Typical end treatments are depicted in Figure 4-2. Safety end treatments (SET), such as those used with driveway and other small diameter culverts, may be more hydraulically efficient by providing both tapered wingwalls and a beveled edge instead of using a mitered section. For larger culverts that are not protected by a railing or guard fence, pipe runners arranged either horizontally or vertically shall be used on all SET installations.

Figure 4-2: Typical Culvert End Treatments



Source: TxDOT HDM [4]

The pipe of pipe runner SETs have been proven to be within the tolerance of the entrance loss equation. Therefore, the entrance should be evaluated solely for its shape and the effect of the pipes on the entrance loss equation should be ignored.

4.6.5 CULVERT HYDRAULICS

The hydraulic design of culverts shall be based upon design guidelines set forth by TxDOT, the U.S. Department of Transportation, or other suitable material as approved by the City. Computer programs such as FHWA's "HY-8" may be used, provided that the design engineer provides output tables showing models results and input data.

Values of entrance loss coefficients (Ce) are shown in Table 4-6 based on culvert shape and entrance condition.

Table 4-6: Entrance Loss Coefficients

Entrance Configuration	Ce
CONCRETE PIPE	
Projecting from fill, socket end (groove end)	0.2
Projecting from fill, square cut end	0.5
Headwall or headwall and wingwalls:	-
Socket end of pipe (groove end)	0.2
Square-edge	0.5
Rounded (radius 1/12 D)	0.2
Mitered to conform to fill slope	0.7
End section conforming to fill slope	0.5
Beveled edges, 33.7º or 45º bevels	0.2
Side- or slope-tapered inlet	0.2
CORRUGATED METAL PIPE OR PIPE ARCH	-
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
End section conforming to fill slope	0.5
Beveled edges, 33.7º or 45º bevels	0.2
Side- or slope-tapered inlet	0.2
REINFORCED CONCRETE BOX	-
Headwall parallel to embankment (no wingwalls):	-
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30º to 75º to barrel:	-
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10º to 25º to barrel: square-edged at crown	0.5
Wingwalls parallel (extension of sides): square-edged at crown	0.7
Side- or slope-tapered inlet	0.2
Source: TxDOT HDM [4]	

There are two categories of flow through culverts: inlet control and outlet control.

a. Inlet Control: The flow is controlled by the cross-sectional area of the culvert, inlet configuration, and headwater depth. Slope, roughness, and length of culvert are of no importance. Nomographs are available for inlet control estimations as proved in Hydraulic Design of Highway Culverts [8].
b. Outlet control: The flow is controlled by the cross-section area of the culvert, inlet configuration, and headwater depth and, slope, roughness and length of culvert. Culverts will be outlet controlled if the culvert slope is relatively flat, the tailwater sufficiently deep, or the culvert is quite long. It is also possible, where the water enters the culvert under inlet control, but the culvert slope, or tailwater conditions cause a hydraulic jump near the outlet. This situation should be avoided because damage can occur to the culvert pipe. Unstable conditions are most likely when the culvert is placed at a near-critical slope.

The design engineer shall calculate both outlet and inlet control conditions and use the more conservative of the two as the design condition.

4.6.6 CULVERT OUTLET PROTECTION

High discharge velocities from culverts can cause eddies or other turbulence, which could damage unprotected downstream channel banks and roadway embankments. To prevent damage from scour and erosion in these conditions, culvert outlet protection is needed. The outlet protection should extend downstream to a point where non-erosive channel velocities or shear stress are established in accordance with Section 4.5.5 of this manual. The outlet protection should be placed sufficiently high on the adjacent banks to extend 1 foot above the design water surface elevation. All outlet protection shall be designed with an appropriate toe depth. All toes shall be no less than twenty-four inches.

4.6.7 ENERGY DISSIPATION

Design of riprap stone protection shall be done in accordance to *HEC 22*. Design of concrete baffles and stilling basins shall be done in accordance with *HEC 14*.

CHAPTER 5 DETENTION FACILITIES

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Detention is the storage of runoff for a controlled release during or immediately following a design storm. The detention facility shall be appropriate to the type of development, topography, and amount of control needed.

5.1 General Requirements

All proposed detention facilities must achieve the following requirements:

a. The method(s) of detention shall be appropriate to the type of development, topography, and amount of control needed. Examples of methods include, but are not limited to, the following:
    a. Basins or swales – single or multiple
    b. Check dams in gullies to slow runoff and trap sediment
    c. Contour terracing, improved vegetation cover
b. Parking areas may be used as detention facilities provided that maximum depths of ponding do not exceed eight inches and ponding is in the areas most remotely situated from structures.
c. Stormwater infiltration systems are not permitted for mitigation in any development where there is ~~a potential~~potential for pollutants to adversely affect ground water quality (e.g. Edwards Aquifer Recharge Zone).
d. No detention basin shall retain standing ~~water~~water for longer than 36 hours unless it is designed and constructed to be a permanent pond with appropriate health, safety and water quality measures. Permanent ponds must comply with all applicable water rights requirements for such a body of water.
e. Detention basins to be excavated shall provide positive drainage through the pond. Consideration should be given to pond slope and erosion protection.
f. Finished floors of adjacent structures should be a minimum of 1 foot above the 100-year water surface in the facility. Facilities should preferably be located such that the invert of the outlet structure is above the 100-year water surface level in the receiving body; but in all cases, facilities shall be designed to function properly during conditions where the outlet is submerged by the tailwater of the receiving stream.
g. Detention facilities shall be designed with one or more outlet structures to allow safe passage of the 100-year post-development design storm runoff. Emergency overflow weirs shall also be required. Overflow weirs shall consider where overflow is directed and where feasible, direct overflows to easements and ROW but shall in no case adversely impact adjacent properties or streams.
h. Weirs, spillways, and outlets shall be protected from erosion with riprap, grouted riprap, or other ~~method~~methods of erosion control to protect the structure and downstream channel. Outflows shall be conveyed within proposed property limits or easement to an appropriate receiving drainage facility in a manner such that roadways, private property, buildings, etc. are not damaged.
i. Best management practices shall be used in the event a detention facility empties into another storage facility downstream. The timing of the hydrograph from the detention facility shall be checked against the timing of the receiving storage facility to prevent any increase in the flow rate from the downstream facility.
j. Side slopes of earthen embankments shall be designed for stability and safety, with side slopes of earthen banks shall be 3H:1V or flatter. All constructed stormwater structures of earthen material shall be re-vegetated to mature growth.
k. Maximum water depths over 6 feet shall not be allowed without prior approval from the City. Any detention facility that is classified as a dam by the TCEQ shall conform to the more stringent of rules listed in this manual or the dam safety rules adopted by TCEQ.

l. Earthen embankments of a height greater than 3 feet used to impound a required detention volume must have a minimum top-width of 4 feet, shall contain a non-permeable core, and shall be based on a geotechnical investigation for the site. Compaction of all earthen drainage structures shall be to 90% standard proctor.

m. A maintenance ramp shall be provided for access in detention basin design for periodic desilting and debris removal. Access shall be provided to all ponds and channel maintained by the City, regional drainage facilities, or any other drainage facility designed for drainage of more than one privately maintained single-family lot as follows: ponds and channels shall provide a maintenance access with a width of at least 12 feet and have a vertical grade no steeper than 6H:1V. Access shall be provided within dedicated ROW or within the drainage easement and shall be clearly identified on plans.

   Maintenance schedules and descriptions of maintenance practices for privately maintained single-family residential ponds and channels shall be provided within the plans or as a separate document. Adequate access shall be provided for the maintenance description provided.

n. Basins with permanent storage must include dewatering facilities to provide for maintenance.

o. The design of detention facilities shall include provisions for collecting and removing sediment deposited after collecting and releasing stormwater.

p. Detention ponds and reservoirs shall provide freeboard based on Table 2-4 of this manual for the 100-year storm event measured from top of berm to the 100-year water surface elevationof the pond.

5.2 Design Criteria

The purpose of a stormwater detention basin is to temporarily impound (detain) excess stormwater, thereby reducing peak discharge rates. Therefore, all detention ponds are to be designed to prevent an increase in flow to the existing ~~2, 10~~5, 25, and 100-year peak runoff leaving a proposed site. The design engineer must use the NRCS unit hydrograph as outlined in Section 3.4 of this manual.

5.3 Outlet Structure Design

To reduce the ~~2, 10~~5, 25, and 100-year post-developed design storm flows to pre-development levels, a multi-level outlet structure may be required. The required documentation for the design of any detention structures ~~include~~includes design hydrographs, calculations of stage-storage-discharge tables, drawings of the basin, spillway, weir and outlet size and location along with necessary erosion control measures. For further guidance for design and construction of outlet structures, the design engineer should reference the Stormwater Detention Outlet Control Structures [9].

5.3.1 ORIFICES

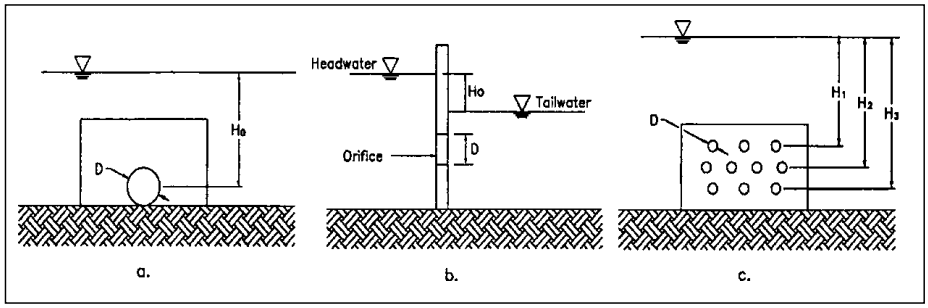
The orifice flow for a single orifice, depicted in Figure 5-1, can be calculated from Equation 5-1.

$$Q = C_0 A_0 (2gH_0)^{0.5} \qquad \text{(Equation 5-1)}$$

Where:

Q= Orifice flow rate (cfs)
C_0= Discharge coefficient 0.40-0.60
A_0= Area of orifice (sf)
H_0= Effective head on the orifice measured from the centroid of the opening (ft) g = Gravitational acceleration = 32.2 ft/s²

Figure 5-1: Definition Sketch for Orifice Flow



Source: HEC 22 [5]

For orifices discharging as a free outfall, the effective head is measured from the centerline of the orifice to the water surface elevation. For submerged orifices, the effective head is the difference in elevation between the upstream and downstream water surface elevations. A submerged orifice can be seen in Figure 5-1(b).

The discharge coefficient for orifices depend on the entrance conditions and shape of the orifice. For a square-edged orifice with uniform entrance conditions, the discharge coefficient should be 0.6. However, for ragged edged orifices, such as occurring when using an acetylene torch to cut the orifice opening into a corrugate pipe, 0.4 should be used for the discharge coefficient.

Design engineers may analyze pipes with a diameter of 1 foot or less as a submerged orifice as long as H_0/D is greater than 1.5. If the diameter of the pipe is greater than 1 foot, it must be analyzed as a discharge pipe and the design engineer must take into account both headwater and tailwater effects.

When dealing with flow through multiple orifices, as seen in Figure 5-1(c), the sum of the flow through each individual orifice is the total flow through them all. For multiple orifices of the same size and operating under the same effective head, the flow through one orifice can be multiplied by the number of openings to find the total flow.

5.3.2 WEIRS

Weirs are typically one of four types: sharp crested, broad-crested, V-notch, or proportional. The following section provides the required relationships for each type of weir. Design procedures are provided in HEC 22.

5.3.2.1 Sharp Crested Weirs

Typical sharp crested weirs are shown in Figure 5-2.

When a sharp crested weir has an end contraction, as shown in Figure 5-2(b), the equation changes, as follows:

$$Q = C_{SCW}(L - 0.2H)H^{1.5} \quad \text{(Equation 5-4)}$$

The Sharp Crested Weir coefficient varies linearly with the ratio H/H_c and is typically set equal to 3.33 (English units) when the ratio of H/H_c is less than 0.3.

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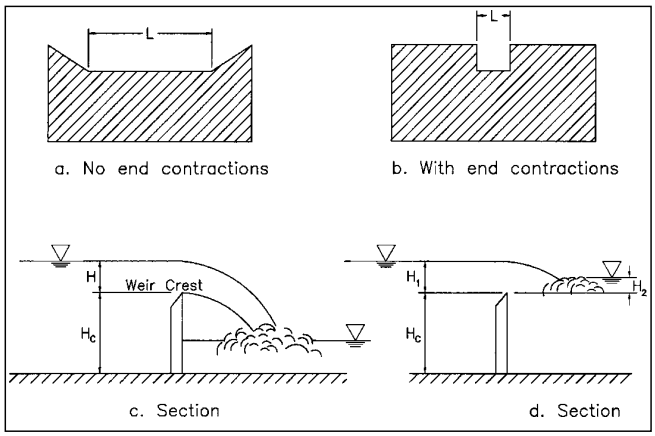
Figure 5-2: Sharp Crested Weirs



Source: HEC 22 [5]

5.3.2.2 Broad-Crested Weir

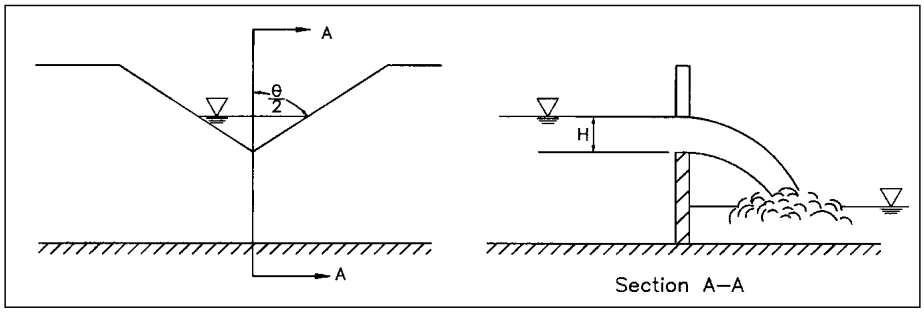
The broad crested weir coefficient is dependent on the breadth of crest of weir and head. Several commonly used broad crested weir coefficients are used for specific cases.

- If the upstream edge of a broad-crested weir is so rounded as to prevent contraction and if the slope of the crest is as great as the loss of head due to friction, flow will pass through critical depth at the weir crest; this gives the maximum C value of 3.09.
- For sharp corners on the broad crested weir, a minimum value of 2.62 should be used.

5.3.2.3 V- Notch Weir

Typical sections for a V-notch weir can be seen in Figure 5-3.

Figure 5-3: V-Notch Weir



Source: *HEC 22* [5]

5.3.2.4 Proportional Weir

Although more complex to design and construct, a proportional weir has the potential to significantly reduce the required storage volume for a given site. Unlike the other three types of weirs, the proportional

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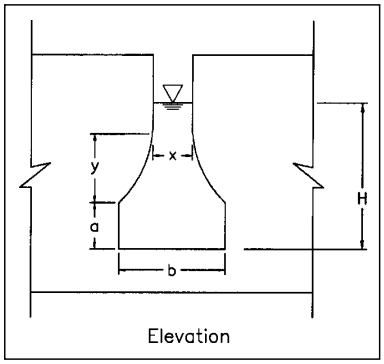
weir has a linear head-discharge relationship. The linear relationship evolves from allowing the discharge area to vary non-linearly with head. Dimensions for a proportional weir are shown in Figure 5-4.

Figure 5-4: Proportional Weir Dimensions



Source: *HEC 22* [5]

5.3.3 DISCHARGE PIPES

Discharge pipes may be used as outlet structures for detention basins. An outlet structure utilizing discharge pipes can be designed one of two ways, either as a single or multistage discharge.

A single discharge system consists of a single discharge pipe or culvert. The single discharge system is designed as a simple culvert would be. As in Section 4.6.3 of this manual, the downstream boundary conditions would be applied in the same manner. The end computations would be a stage-discharge curve developed for the full range of flows that the single system may experience. The single pipe does not include a system to carry emergency flows.

A multistage discharge system does include a control structure at the inlet end of the pipe. This inlet control structure must be designed with the full range of flows under consideration. As with the single discharge system, a stage-discharge curve would be developed for all potential flows the system may experience. The design flows will typically be orifice flow through whatever shape the designer has chosen while the higher flows will typically be weir flow over the top of the control structure.

Orifices can be designed as outlined in Section 5.3.1 and weirs can be designed as shown in Section 5.3.2. The pipe must be designed to carry all flows considered in the design of the control structure.

In designing a multistage structure, the designer would first develop peak discharges that must be passed through the facility. The second step would be to select a pipe that will pass the peak flow within the allowable headwater and develop a performance curve for the pipe. Thirdly, the designer would develop a stage-discharge curve for the inlet control structure, recognizing that the headwater for the discharge pipe will be the tailwater that needs to be considered in designing the inlet structure. Last, the designer would use the stage-discharge curve in the basin routing procedure.

5.3.4 EMERGENCY OVERFLOW WEIRS

When storms occur, resulting in storm flows exceeding the design discharge of the detention basin, emergency overflow weirs allow a controlled relief of the excess water. Typically, an emergency overflow weir has a trapezoidal cross-section design for its constructability. For small ponds with outfall structures comprising of pipe-systems, an emergency weir will need to be designed to carry the full 100-year storm, assuming all pipes are blocked. For larger ponds with outfall structures comprising of box culverts or graduated weirs, the emergency weir

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will be designed to carry the 500-year storm event. The typical emergency overflow weir is

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shown in Figure 5-5. Emergency overflow weirs that do not incorporate a spillway should be treated as a broad-crested weir.

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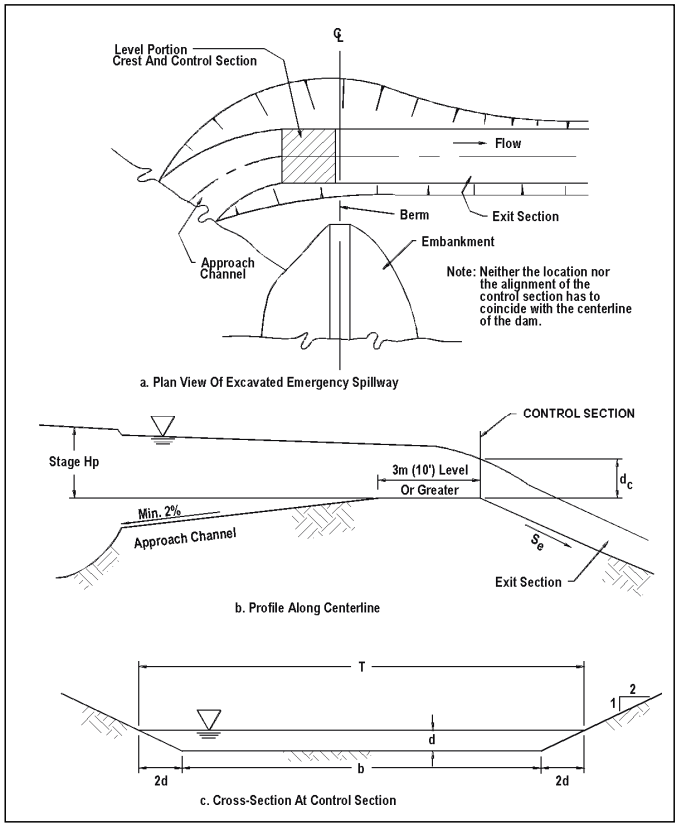
Figure 5-5: Emergency Spillway Design Schematic



Source: *HEC 22* [5]

The discharge coefficient varies as a function of the bottom width of the spillway and the effective head on the spillway. Design parameters for the relationship are included in HEC 22.

The critical slopes are based upon an assumed Manning's coefficient of 0.040 for turf cover of the spillway. For a paved spillway the Manning's coefficient should be 0.015. The Manning's coefficient is dependent on the spillway material and must be adjusted according to the design developed by the design engineer.

CHAPTER 6 MITIGATION OPTIONS

Mitigation options other than detention would include constructing improvements, or other measures that mitigate or otherwise improve the water course's ability to handle increased runoff from the site without causing adverse impact to adjacent or downstream properties.

Examples could include:

- Low Impact Development (LID) Features
- Improving off-site drainage infrastructure
- Swales
- Channels
- Storm Drain installation or upsizing
- Culverts
- Clearing of underbrush
- Shared drainage easement between the adjacent owners with an agreement per state law.

It should be noted that some of these options may require drainage easements from adjacent property owners or at a minimum written permission from these property owners to access the property.

The options listed above are some potential opportunities of consideration. Alternatively, the user may evaluate opportunities to not provide detention and directly consider improving impacted infrastructure. Lastly, the user may provide detention and mitigate the increase in flow, so there is no longer an impact to the downstream infrastructure. Detention will be used as a last-resort mitigation option and only allowed with the City Engineer's approval. Detention requirements may be waived if 50% of newly proposed impervious cover is treated with LID features and no adverse impact can be demonstrated (request for waived detention must be proposed during the permitting process of newly proposed impervious cover).

If the user has a reasonable explanation for not providing detention, they may consider the following:

- If there is any storm drainage infrastructure such as storm-inlets, culverts, etc: Then the user may consider upsizing the culverts by including additional pipes or boxes; may consider upsizing the inlet capacity to a larger inlet size and further replace underground storm pipes to accommodate the excess flow.
- If the flow goes through other properties, the user may consider channeling it to keep the flow extents same as existing conditions. This can be done using engineering channels such as grass-lined or concrete lined (which need maintenance) or can be done using vegetated swales which need less maintenance.
- For minor increases in flow, the user may consider clearing existing underbrush on the downstream side, to be able to reduce the manning's roughness coefficients, which can achieve a reduction in water surface elevations.
- Also, for minor increases in flow, a LID feature may be included which could potentially help with mitigating both water quantity and quality.

A shared drainage easement between the adjacent property owners, established and governed by a written agreement executed and recorded in accordance with applicable state law. The easement designates a defined area for the conveyance of flow and/or drainage improvements, and grants each owner the continuing right to use, access, and maintain the drainage facilities within that area. Both owners are obligated to preserve the intended drainage function, refrain from obstructing or altering the easement in a manner that interferes with water flow, and comply with all maintenance, repair, and cost-sharing responsibilities as outlined in the agreement.~~a agreement with their willingness to from the originator. The agreement at a minimum should include the~~

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~~following information:~~

- ~~Identification of all parties: The agreement should identify the originator and all impacted parties that will receive excess runoff from the originator's property.~~
- ~~Property Descriptions: The agreement should include property addresses, parcel IDs, legal descriptions of all properties involved in this agreement. Additionally, it should also include the source of flooding and a sketch/exhibit showing property boundaries, stormwater source and mapping; and should highlight areas being impacted.~~
- ~~Purpose: The agreement will mention information relevant to the onsite and offsite hydrologic and hydraulic analyses and should quantify the stormwater impacts on the adjacent property owners.~~
- ~~Authentication: The city will accept agreements prepared and authenticated by a licensed Real Estate Attorney, hired by the originator.~~
- ~~Signatures: The agreement will be signed and notarized by all parties~~
- ~~, without any current or future concer~~

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6.1 Low Impact Development (LID) Features

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Low Impact Development (LID) Features as an alternative to traditional detention can often be incorporated into landscaping to provide aesthetics without requiring additional disturbance or requiring off-site improvements. For further guidance, reference the latest published Travis County Low Impact Development standards.

Examples could include:

- Biofiltration ponds
- Rain gardens
- Rainwater harvesting
- Irrigation & Infiltration fields
- Sedimentation filtration ponds
- Vegetated filter strips
- Wet ponds
- Vegetated rooftops
- Permeable pavement
- Bioswales
- Planter Boxes

CHAPTER 7 ADVERSE IMPACT ANALYSIS

In many cases the proposed development will not cause an adverse impact on adjacent properties, or detention may cause increased impact.

Examples include:

- Discharge directly into a natural or manmade waterway with adequate capacity
- Increase onsite flow path length and incidental storage
- Point discharge from detention basins
- Timing of hydrographs

Methods to verify no adverse impact include: Mitigation through LID features, downstream drainage infrastructure improvements or detention. Engineer of Record to provide analysis and supporting data that verify No-Adverse Impact. A detailed hydrologic analysis is defined as a computer model based on rainfall-runoff methodology using software similar to HEC-HMS. A detailed hydraulic analysis is defined as a computer model that calculates water surface elevations using a step-backwater method; such as HEC-RAS. Two-Dimensional models that can dynamically integrate hydrology and hydraulics, such as XP-SWMM, ICM or HECRAS 2D, can also be used for detailed analysis submittal. The purpose of the detailed analysis is to demonstrate no increases to the 5-yr, 25-yr and 100-year water surface elevations at a point just downstream of the site and at a zone of influence point established based on the 10% drainage area rule.

7.1 10% Zone of Influence

Engineer to analyze the watershed to a point where the site represents 10% of the total watershed. For example, if a site is 2 acres. The engineer will study the flow path to a point where the watershed is a total of 20-acres or greater. The engineer must show through analysis and data that the proposed development of the 2 acres site will not cause an adverse impact within this 20-acre watershed. If there is an adverse impact, then mitigation will be required.

7.2 Natural Water Courses

Water courses with drainage areas in excess of 100 acres will require detailed hydrology and hydraulic analysis to determine the flood inundation area within the property. The flood inundation area must be dedicated as a public drainage easement to allow for future maintenance and preservation of the natural water course.

7.3 Drainage Easements

Sites located within a FEMA-Designated Floodplain

When a site is located within a FEMA-designated floodplain, a drainage easement is required to preserve the hydraulic conveyance of the floodplain and to prevent adverse impacts to upstream and downstream properties. The easement ensures that flood flows can pass through the site without obstruction and provides access for inspection, future maintenance and flood risk management.

The Engineer shall provide a detailed flood study report that includes analysis supporting the FEMA Effective Floodplain, as well as any Best Available Model (BAM) (e.g., updated HEC-RAS models, restudies, or locally adopted models). The analysis shall establish the 1% annual chance (100-year) floodplain limits and associated water surface elevations.

If discrepancies exist between the FEMA Effective Floodplain and the Best Available Model, the Engineer shall compare the extents and water surface elevations and adopt the more conservative (wider) floodplain limits. The drainage easement boundaries shall be designated based on these limits to ensure adequate flood conveyance capacity and regulatory compliance. The easement shall fully encompass the floodplain and any additional area necessary to accommodate freeboard, maintenance access, and future model updates.

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Sites not adjacent to a FEMA-Designated Floodplain

For sites not adjacent to FEMA-designated floodplain but are within a regulated stream (shown in Appendix C), ~~have a contributing drainage area exceeding 200 acres,~~ a drainage easement is required due to the potential for significant stormwater runoff, flood conveyance needs, and potential impacts to adjacent properties.

For drainage areas exceeding 200 acres the Engineer shall conduct a 100-year ultimate development flood study to define the limits of the 1% annual chance (100-year) inundation boundary. The analysis shall evaluate existing, proposed, and ultimate development conditions and downstream tailwater impacts.

Based on the results of the flood study, the Engineer shall delineate the limits of the potential 100-year ultimate conditions floodplain. The drainage easement shall be sized to fully contain the modeled flood extents and provide adequate capacity for safe conveyance of runoff, sediment transport, and debris passage. The easement also serves to protect flood conveyance and ensures long-term access for inspection and maintenance.

7.4 Street Discharge

When a site discharges directly into the existing streets which do not have existing stormwater infrastructure in place (regardless of drainage area) the property owner must dedicate a drainage easement at least 15' wide across the frontage of the property to allow for the construction and maintenance of drainage facilities.

7.5 Point Discharge

Concentration of runoff from a sheet flow condition into a point discharge will require an easement from the receiving property. This easement must be adequate to contain the received runoff during a ~~25~~ 100-year design storm event. Alternatively, the point discharge must be returned to a sheet flow condition using a level spreader or other method sufficiently upstream of the property line to allow runoff to fully return to a sheet flow condition before reaching the property line.

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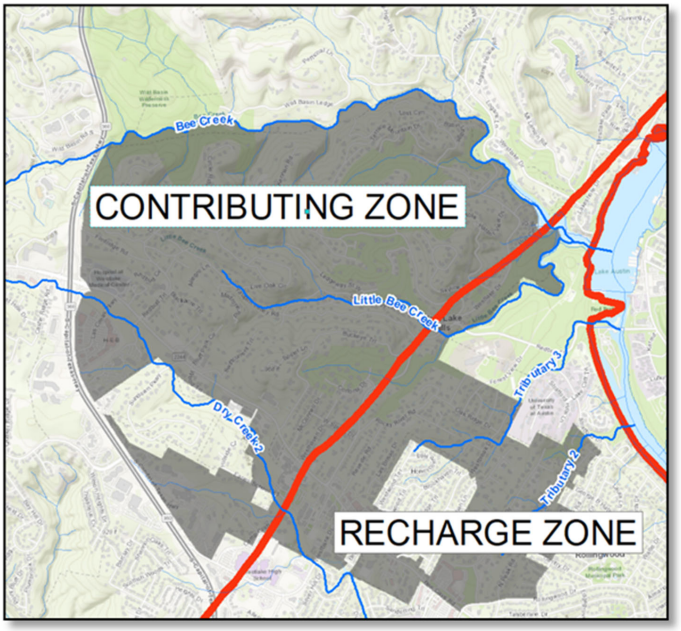
CHAPTER ~~6~~8 WATER QUALITY CONTROLS

Stormwater can have a significant impact on water quality in creeks and rivers within and downstream of the City. To maintain the integrity of the natural environment, the City requires controls to remove suspended particulate matter and associated constituents such as bacteria, nutrients, and metals from stormwater discharges.

~~6.1~~8.1 Applicability

Permanent water quality controls for all developments within the City shall comply with the latest TCEQ published rules and technical design guidance. The selected Best Management Practice (BMP) or combination of BMPs must reduce the increase in total suspended solids (TSS) load associated with development by at least 80 percent. ~~Single-family residential developments with less than 20% impervious cover are not required to treat stormwater discharges. For developments within the Edwards Aquifer Recharge Zone, TCEQ approval is required.~~ All single-family residential developments with impervious cover above 20% must provide water quality treatment for both the Recharge and Contributing Zones.



~~6.2~~8.2 Design Criteria

Permanent water quality BMPs shall be designed to provide adequate treatment of impervious cover in the City's Jurisdiction. The selection and sizing of BMPs shall follow the procedures outlined in the latest version of the TCEQ Report Publication RG-348 [10], as amended. All BMPs included in the errata sheet and addendums are accepted for use.

8.3 Maintenance

The maintenance requirements for BMPs as defined by TCEQ must be followed for all BMPs and is the responsibility of the property owner. A copy of the recorded maintenance plan, as required by TCEQ, shall be provided to the City. Documentation of annual inspections required by the City or TCEQ shall be submitted to the City each year. Changes in the ownership and responsibility provided to TCEQ shall also be

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provided to the City of West Lake Hills.

8.4 Rainwater Harvesting System

For water quality determination, roof areas connected to a rainwater harvesting system do not count towards impervious cover for low density single-family residential developments. Applicants proposing a rainwater harvesting system at a minimum need to provide two impervious cover calculations, one to comply with building regulations and the other to comply with TCEQ.

If sized per the provided guidelines, developments can be exempt from the Edwards Aquifer protection plan application requirements by reducing the effective impervious cover below 20%. The volume of the rainwater collection system must be sufficient to retain the runoff from a 1.5-inch rainfall for all impervious cover above 20%. The rainwater harvesting container is to be sized for the entire roof area draining to the rainwater harvesting system if that area is larger than the area needed to bring the total impervious cover of the site below 20%. The system should be managed so that it is emptied at least weekly to provide storage for subsequent storms. This guidance is provided for reference only, applicants are advised to periodically check for updates to TCEQ guidelines, as TCEQ regulations take precedence. Within the drainage plan set, the rainwater harvesting system plan sheet should include a plan view identifying rooftop high points and gutter locations. The roof area contributing runoff to the storage tank must be clearly defined and delineated.

Formulas:

Required Water Quality (%) = ((Impervious Cover (ft^2) / Area of property (ft^2)) - 0.2) (100)

Minimum Rooftop Collection Area (ft^2) = Impervious Cover (ft^2) - (Area of property (ft^2) / 5)

*Minimum Tank Size (gallons) = ((Minimum Rooftop Collection Area (ft^2) x 144 in^2/ft^2) (1.5 in)) / 231 in^3/gal

*Actual Tank Size (gallons) = ((Actual Rooftop Collection Area (ft^2) x 144 in^2/ft^2) (1.5 in)) / 231 in^3/gal

*Round up to the nearest gallon

~~6.3~~ ~~The maintenance requirements for BMPs as defined by TCEQ must be followed for all BMPs and is the responsibility of the property owner. A copy of the recorded maintenance plan, as required by TCEQ, shall be provided to the City. Documentation of annual inspections required by the City or TCEQ shall be submitted to the City each year. Changes in the ownership and responsibility provided to TCEQ shall also be provided to the City.~~

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CHAPTER ~~7~~9 EROSION CONTROL MEASURES

Private property owners, developers, or builders shall be accountable for erosion of their property or construction site which results in measurable accumulation of sedimentation in dedicated streets, alleys, waterways, or other properties. Sediment carried by stormwater runoff shall be prevented from entering storm drain systems and natural ~~watercourses~~water courses.

~~7.1~~9.1 General Requirements

a. Maximum use shall be made of vegetation to minimize soil loss. Vegetation measures should begin as soon as possible during construction in order to allow for establishment at construction termination.
b. Natural vegetation should be retained wherever ~~possible~~possible, including trees. Where inadequate natural vegetation exists or where it becomes necessary to remove existing natural vegetation, temporary controls should be installed promptly to minimize soil loss and ensure that erosion and sedimentation does not occur.
c. During construction, erosion controls shall be used to slow drainage flow rate and prevent downstream sedimentation.
d. Erosion control elements should be implemented as soon as practical in the development process.
e. Waste or disposal areas and construction roads should be located and constructed in a manner that will minimize the amount of sediment entering streams.
f. Frequent fording of live streams will not be permitted; therefore, temporary bridges or other structures shall be used wherever an appreciable number of crossings of a stream are necessary.
g. When work areas or material sources are located in or adjacent to live streams, such areas shall be separated from the stream by a dike or other barrier to keep sediment from entering a flowing stream. Care shall be taken during the construction and removal of such barriers to minimize the sediment transport into a stream.
h. Should preventative measures fail to function effectively, the applicant shall act immediately to bring the erosion and/or siltation under control by whatever additional means are necessary.
i. Erosion control devices shall be placed to trap any losses from stockpiled topsoil. Some acceptable forms of site erosion control devices include, but are not limited to, silt fences, silt traps, and geotextiles. Hay bales are not permitted.
j. The selection and timing of the installation of erosion controls shall be based upon weather and seasonal conditions that could make certain controls not practicable.
k. Vegetation used ~~for vegetative~~for ~~cover~~vegetative ~~shall~~cover ~~be~~shall ~~suitable~~be suitable for local~~.~~ soil~~.~~ and weather~~.~~ conditions. Ground cover plants shall comply with listings from the Texas Agricultural Extension Service.
l. Stripping of vegetation from project sites shall be phased so as to expose the minimum amount of area to soil erosion for the shortest possible period of time. Phasing shall also consider the varying requirements of an erosion control plan at different stages of construction and shall include the establishment of new vegetation or permanent erosion control measures.
m. SWPPP shall follow TCEQ rules.

~~7.2~~9.2 Edwards Aquifer

Development and redevelopment located over the Edwards Aquifer regulatory zones shall comply with the latest TCEQ published rules and technical design guidance for the Edwards Aquifer in accordance with 30 TAC Chapter 213 (Edwards Aquifer Rule) in addition to the provisions and requirements of TPDES General Permit Number TXR150000.

~~7.3~~9.3 Temporary Erosion Control Measures (used during construction)

Erosion control and restoration measures shall be designed in conformance with the methods established by the TPDES General Permit Number TXR150000 regardless of disturbed acreage. TCEQ Report Publication RG-348 outlines the selection and design of temporary erosion control and sediment control measures.

~~7.3.1~~ ~~Maintenance and Monitoring~~

~~Required temporary erosion control measures are to be installed prior to commencing construction and shall remain in place until vegetation is established and the construction area is stabilized. During the course of construction, the property owner is responsible for maintaining the integrity of all temporary erosion control measures. Maintenance requirements for the BMPs are included in TCEQ RG-348. In general, the site and vicinity shall be clear of debris and sediment. The property owner is responsible for cleaning and removing all sediment discharged from the site during the construction at the direction of the City.~~

9.3.1 Maintenance and Monitoring

Required temporary erosion control measures are to be installed prior to commencing construction and shall remain in place until vegetation is established and the construction area is stabilized. During the course of construction, the property owner is responsible for maintaining the integrity of all temporary erosion control measures. Maintenance requirements for the BMPs are included in TCEQ RG-348. In general, the site and vicinity shall be clear of debris and sediment. The property owner is responsible for cleaning and removing all sediment discharged from the site during the construction at the direction of the City.

~~7.3.2~~9.3.2 Final Acceptance

All site related items must be complete in accordance with this Drainage and Erosion Control Design Manual prior to occupancy of the last building on a site. All subdivision-related drainage items must be completed prior to the recordation of the final plat. A Letter of Concurrence is required from the Engineer certifying completion of all stormwater detention and water quality management facilities prior to final acceptance.

~~7.4~~9.4 Permanent Erosion Control Measures

Natural drainage patterns shall be preserved whenever possible. Drainage patterns should be designed to prevent erosion, maintain filtration and recharge of local seeps and springs, and attenuate the harm of contaminants collected and transported by storm water.

~~7.4.1~~9.4.1 Cut/Fill Limits

In order to reduce stormwater runoff, resulting in erosion, sedimentation and conveyance of nonpoint source pollutants, the layout of the street network, lots and building sites shall, to the greatest extent possible, be sited and aligned along natural contour lines, and shall minimize the amount of cut and fill on slopes in order to minimize the amount of land area disturbed during construction. To determine average slope a total of up to five (5) continuous 1' contours can be used in the analysis. The maximum cut and fill limits are shown in Table ~~9~~7-1. Structures utilizing piers or cantilever structures over area left natural are not subject to cut / fill limits.

Table ~~9~~7-1: Maximum Cut and Fill Limits

Slope	Open Cuts and Fills	Closed Cuts	Closed Fill
0 - 15%	3 feet	20 feet	6 feet
15 - 25%	1 foot	15 feet	6 feet

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25% - 35%	0 feet	10 feet	6 feet
> 35%	0 feet	0 feet	0 feet

~~7.4.2~~9.4.2 STREAM BANK EROSION

Erosion control will be provided along streams and drainage channels. Where bank stabilization or other erosion protection measures are required to protect streams and channels, mitigation measures shall be detailed and calculations provided.

Appendix A: References

[1] W. Asquith, "Depth-Duration-Frequency of ~~Precipitiation~~Precipitation for Texas," US Geological Survey Water
Resources Investigations Report 98-4044, ~~Austin,TX~~Austin, TX, 1998.

[2] "Urban Hydrology for Small Watersheds - Technical Release 55," Natural Resources Conservation Services, Washington, D.C., 1986.

[3] City of Austin, Drainage Criteria Manual, Austin, 2014.

[4] Texas Department of Transportation, "Hydraulic Design Manual," Austin, TX, 2016.

[5] US Department of Transportation, Federal Highway ~~Adminstration~~Administration, "Urban Drainage Design Manual, Hydraulic Engineering Circular No. 22," 3rd Edition, Washington, D.C, 2009.

[6] US Department of Transportation, Federal Highway ~~Adminstration~~Administration, "Design of Roadway Channels with Flexible Linings, Hydraulic Engineering Circular No. 15," 3rd Edition, Washington, D.C., 2005.

[7] US Department of Transportation, Federal Highway Administration, "Hydraulic Design of Energy Dissipaters for Culverts and Channels, Hydraulic Engineering Circular No. 14," 3rd Edition, Washington, D.C., 2006.

[8] US Department of Transportation, Federal Highway ~~Adminstration~~Administration, "Hydraulic Design of Highway Culverts, Hydraulic Design Series No 5," 3rd Edition, Washington, D.C., 2012.

[9] J. Jones, "Stormwater Detention Outlet Control Structures," *Great Works on Urban Water Resources,* Vols. 1962-2001, pp. 857-887, 2006.

[10] TCEQ, "Complying with Edwards Aquifer Rules Technical Guidance on Best Management Practices," Austin, Texas, July 2005.

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Appendix B: Definition of Terms

100- year Event: Event (rainfall or flood) that statistically has a one percent chance of being equaled or exceeded in any given year.

Abutment: A wall supporting the end of a bridge or span, and sustaining the pressure of the abutting earth.

Apron: A floor or lining of concrete, timber, or other suitable material at the toe of a dam, entrance or discharge side of spillway, a chute, or other discharge structure, to protect the waterway from erosion from falling water or turbulent flow.

Backwater: The rise of the water level upstream due to an obstruction or constriction in the channel.

Baffles: Deflector vanes, guides, grids, gratings, or similar devices constructed or placed in flowing water to: (a) check or effect a more uniform distribution of velocities; (b) absorb energy; (c) divert, guide, or agitate the liquids; and (d) check eddy currents.

Calibration: Process of checking, adjusting, or standardizing operating characteristics of instruments and model appurtenances on a physical model or coefficients in a mathematical model. The process of evaluating the scale readings of an instrument in terms of the physical quantity to be measured.

Channel: Any path of concentrated flow that conveys storm runoff from a drainage area greater than 128 acres.

Channel stability: A condition in which a channel neither degrades to the degree that structures, utilities or private property are endangered, nor aggrades to the degree that flow capacity is significantly diminished as a result of one or more storm runoff events or moves laterally to the degree that adjacent property is endangered.

Closed cut: Excavations that prevent erosion by some permanent erosion control structure such as a reinforced concrete retaining wall, dry stacked stone, or other permanent erosion control device.

Closed fill: Embankments that prevent erosion by some permanent erosion control structure such as a reinforced concrete retaining wall, dry stacked stone, or other permanent erosion control device, including building foundations.

Conduit: Any open or closed device for conveying flowing water.

Critical Flow: The state of flow for a given discharge at which the specific energy is a minimum with response to the bottom of the conduit.

Crown: (a) The highest point on a transverse section of conduit; (b) the highest point of a roadway cross section.

Culvert: Large pipe or other conduit through which a stormwater flows under a road or street.

Curb Inlet: A vertical opening in a curb through which the gutter flow passes. The gutter may be undepressed or depressed in the area of the curb opening.

Degradation: The progressive general lowering of a stream channel by erosion.

Depression Storage: Collection and storage of rainfall in natural depressions (small puddles) after exceeding infiltration capacity of the soil.

Design Storm. The storm which is used as the basis for design, i.e., against which the structure is designed to provide a stated degree of protection or other specified result.

Detention: The storage of storm runoff for a controlled release during or immediately following the design storm.

a. **Off-site detention:** A detention pond located outside the boundary of the area it serves.

b. **On-site detention:** A detention pond which is located within and serves only a specific site or subdivision.

c. **On-stream detention:** Detention facilities provided to control excess runoff based on a watershed wide hydrologic analysis.

Developed land: Any lot or parcel of land occupied by any structure intended for human occupation, including structures intended for commercial or industrial enterprise.

Developer: Any individual, estate, trust, receiver, cooperative association, club, corporation, company, firm, partnership, joint venture, syndicate or other entity engaging in platting, subdivision, filling, grading, excavating, or construction of structures.

Disturbed area: Area impacted by construction including all vehicle access, material storage, building construction, pavement, and necessary workspace for construction

Downstream capacity: The ability of downstream drainage facilities to accept and safely convey runoff generated upstream.

Drainage basin: The storm water catchment area above a point on a channel to which waters drain and collect. Watershed has the same meaning.

Drainage easement: A platted area reserved for the primary purpose of stormwater drainage and maintenance.

Drainage System: Drainage systems shall include streets, alleys, storm drains, drainage channels, culverts, bridges, overflow swales, and any other facility through which or over which storm water flows.

Drop Inlet: A storm drain intake structure typically located in unpaved areas. The inlet may extend above the ground level with openings on one or more sides or it may be flush with the ground with a grated cover.

Entrance Head: The head required to cause flow into a conduit or other structure; it includes both entrance loss and velocity head.

Entrance Loss: Head lost in eddies or friction at the inlet to a conduit, headwall or structure.

Erosion control: Treatment measures for the prevention of damages due to soil movement and to deposition.

Excavation: Digging and removal of earth by mechanical means.

Fill: The placement of material such as soil or rock to replace existing material, or to create an elevated embankment. Fill also refers to the material which is placed.

Flood or Flooding: A general and temporary condition of inundation of normally dry land areas by surface runoff. The 100-year flood is the flow rate with a 1% probability of being equaled or exceeded in any one year.

Flood Hazard Area: Area subject to flooding by 100-year frequency floods.

Floodplain: Geographically the entire area subject to flooding. In usual practice, it is the area subject to flooding by the 100-year frequency flood. In this manual, the "100-year floodplain" refers to the floodplain resulting from a 100-year flood based on ultimate watershed development conditions. The "FEMA floodplain" shall refer to the area subject to flooding resulting from the 100-year flood for current watershed development conditions.

Freeboard: The distance between the normal operating level and the top of the side of an open conduit left to allow for wave action, floating debris, or any other condition or emergency without overtopping the structure.

Frequency: Average recurrence interval of a given storm event over long periods of time.

Froude Number: A flow parameter which is a measure of the extent to which gravitational action affects the flow. A Froude number greater than one indicates supercritical flow and a value less than one indicates subcritical flow.

Fully developed watershed: A hydrologic condition in which all areas upstream and downstream of a point in question are assumed completely developed, including any undeveloped areas, which are assumed to be developed in accordance with development densities established by the City

Gabion: A wire basket containing earth or stones, deposited with others to provide protection against erosion.

Grade: (a) The inclination or slope of a channel, canal, conduit, etc., or natural ground surface, usually expressed in terms of the percentage of number of units of vertical rise (or fall) per unit of horizontal distance. (b) The elevation of the bottom of a conduit, canal, culvert, sewer, etc. (c) The finished surface of a canal bed, road bed, top of an embankment, or bottom of excavation.

Grading: Any movement of soil, rock, or vegetation by artificial means, to include any or all of the following acts: clearing, grubbing, excavating, placement of fill material, or grading of land.

Grate Inlet: An opening in the gutter covered by one or more grates through which the water falls. As with all inlets, grated inlets may be either depressed or undepressed and may be located either on a continuous grade of in a sump.

Gutter: A generally shallow waterway adjacent to a curb, used or suitable for drainage of water.

Headwater: (a) The upper reaches of a stream near its sources; (b) the region where ground waters emerge to form a surface stream; (c) the water upstream from a structure.

Hydraulic Control: The hydraulic characteristic which determines the stage discharge relationship in a flowing stream or conduit. The control is usually critical depth, tailwater depth or uniform depth.

Hydraulic Grade Line: A line representing the pressure head available and elevation head at any given point within the system.

Impervious: A term applied to a material through which water cannot pass, or through which water passes with great difficulty.

Infiltration: (a) The entering of water through the interstices or pores of a soil or other porous medium; (b) the quantity of groundwater which leaks into a sanitary or combined sewer or drain through defective joints, breaks or porous walls; (c) The absorption of water by soil, either as it falls as precipitation or from a stream flowing over the surface.

Inlet: (a) An opening into a storm sewer system for the entrance of surface storm runoff, more completely described as a storm sewer inlet; (b) a structure at the diversion end of a conduit; (c) the upstream connection between the surface of the ground and a drain or sewer, for the admission of surface or storm water.

Interception: As applied to hydrology, refers to the process by which precipitation is caught and held by foliage, twigs, and branches of trees, shrubs and buildings, never reaching the surface of the ground, and then lost by evaporation.

Invert: The floor, bottom, or lowest portion of the internal cross-section of a conduit. Used particularly with reference to storm drains, sewers, tunnels, channels and swales.

Lag Time: In hydrograph analysis lag time is the time from the centroid of the mass of excess rainfall to the peak of the runoff hydrograph. See Time of Concentration.

Lining: The material placed on the sides and/or bottom of a ditch, a channel, and/or a reservoir to prevent or reduce seepage of water through the sides and bottom and/or to prevent erosion.

Maintenance: The cleaning, shaping, grading, repair, and minor replacement of drainage, flood control and erosion facilities, but not including the cost of power consumed in the normal operation of pump stations.

Manning's Coefficient: The coefficient of friction used in the Manning Equation to describe the surface roughness characteristics of a channel, floodplain, or sheet flow surface.

Manning's Equation: A uniform flow equation used to relate velocity, hydraulic radius and the energy gradient.

NRCS Runoff Curve Number: Index number used by the Soil Conservation Service as a measure of the tendency of rainfall to run off into streams rather than evaporate or infiltrate.

Open Channel: The general term for a conduit in which water flows with a free surface.

Open cut: Excavations that will not contain any form of permanent erosion control other than planting of ground cover.

Open fill. Embankments that will not contain any form of permanent erosion control other than planting of ground cover.

Orifice: (a) An opening with closed perimeter and regular form in a plate, wall, or partition, through which water may flow; (b) the end of a small tube, such as a Pitot tube, piezometer, etc.

Peak Flow: The maximum rate of runoff during a given runoff event.

Permeability: The property of a material which permits movement of water through it when saturated and actuated by hydrostatic pressure.

Pervious: Applied to a material through which water passes relatively freely.

Post development: The condition of the given site and drainage area after the anticipated development has taken place.

Precipitation: Any moisture that falls from the atmosphere, including snow, sleet, rain and hail.

Preliminary Drainage Plan: A schematic layout of the drainage system required for platting. The Preliminary Drainage Plan shall show locations of channels, storm sewers, detention structures, floodplain, floodway, and associated drainage easements at a minimum.

Pre-development: The condition of the given site and drainage area prior to development.

Rainfall Duration: The length of time over which a single rainfall event occurs.

Rainfall Intensity: The rate of rainfall, usually in inches or millimeters per hour.

Rational Formula: A traditional means of relating runoff from a drainage basin to the intensity of the storm rainfall, the size of the basin, and the characteristics of the basin (such as land use, impervious cover).

Reach: Any length of river or channel. Normally refers to sections which are uniform with respect to discharge, depth, area or slope, or sections between gagging stations.

Return Period: The average interval of time within which a given event is statistically predicted to be equaled or exceeded once.

Riprap (Revetment). Forms of bank channel protection, usually using rock or concrete. Riprap is a term sometimes applied to stone which is dumped rather than placed more carefully.

Right-of-way (ROW). A strip of land dedicated for public streets and/or related facilities, including utilities, drainage systems and other transportation uses.

Runoff: That part of the precipitation that exceeds the precipitation lost to evaporation, transpiration, interception, depression storage, and infiltration and reaches a stream or storm drain.

Runoff Coefficient: A decimal number used in the Rational Formula, which defines the runoff characteristics (i.e., land use impervious cover) of the drainage area under consideration. It may be applied to an entire drainage basin as a composite representation or it may be applied to a small individual area such as one residential lot.

Scour: The erosive action of running water, in streams or channels, in excavating and carrying away material from the bed and banks.

Sediment: Material of soil and rock origin transported, carried, or deposited by flowing water.

Sidewalk: A paved area within the street right-of-way specifically designed for pedestrians and/or bicyclists.

Soffit: The top of the inside of a pipe. In a pipe, the uppermost point on the inside of the structure.

Spillway: A waterway in or about a dam or other hydraulic structure for the escape of excess water.

Stilling Basin: Pool of water conventionally used, as part of a drop structure or other structure, to dissipate energy.

Subcritical Flow: Relatively deep, tranquil flow with low flow velocities. The Froude Number is less than 1.0 for subcritical flow conditions.

Supercritical Flow: Relatively shallow, turbulent flow with high velocities. The Froude Number is greater than 1.0 for supercritical flow conditions.

Tailwater: The depth of flow in the stream directly downstream of a drainage facility or other man made control structure.

Time of Concentration: The estimated time in minutes required for runoff to flow from the most hydraulically remote section of the drainage area to the point at which the flow is to be determined. Hydraulically remote refer to the travel path with the longest flow travel time, not necessarily the longest linear distance.

Ultimate Development: The condition of the watershed after the entire watershed has undergone development.

Unit Hydrograph: The direct runoff hydrograph resulting from one inch of precipitation excess, distributed uniformly over a watershed for a specified duration.

Watershed: The area contributing storm runoff to a stream or drainage system. Other terms are drainage area, drainage basin, and catchment area.

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RESIDENTIAL DEVELOPMENT FLOWCHART

START

IS THE PROPERTY WITH-IN 100 FT OF A FEMA DESIGNATED FLOODPLAIN OR REGULATED STREAM SHOWN IN APPENDIX C OF THE DECDM?

YES

APPLY FOR FLOODPLAIN PERMIT

NO

IS WORK PROPOSED WITH-IN PUBLIC EASEMENT?

YES

NO

PROPOSED INCREASE IN IMPERVIOUS COVER

≥1,000 SF

<1,000 SF RUNNING TOTAL OVER PAST 5 YEARS

IMPERVIOUS COVER PERCENTAGE OF TOTAL SITE, NOT JUST PROPOSED IMPROVEMENTS

≥20%

<20%

WILL PROJECT BE PERMITTED THROUGH TCEQ?

YES

NO

WPAP/CZP APPROVAL LETTER NEEDS TO BE PROVIDED BEFORE CITY PERMIT APPROVAL

UTILIZE RAINWATER HARVESTING SYSTEM FOR ALL IMPERVIOUS COVER OVER 20% AS TCEQ EXEMPTION. REFERENCE THE DRAINAGE AND EROSION CONTROL MANUAL SECTION 8.4 FOR FURTHER DETAIL

TYPE II DEVELOPMENT

TYPE I DEVELOPMENT

NON-RESIDENTIAL DEVELOPMENT FLOWCHART

START

IS THE PROPERTY WITH-IN 100 FT OF A FEMA DESIGNATED FLOODPLAIN OR REGULATED STREAM SHOWN IN APPENDIX C OF THE DECDM?

- YES → APPLY FOR FLOODPLAIN PERMIT
- NO → VARIANCES/SPECIAL USE PERMIT?

VARIANCES/SPECIAL USE PERMIT?

- YES
- NO → IS WORK PROPOSED WITH-IN PUBLIC EASEMENT?

IS WORK PROPOSED WITH-IN PUBLIC EASEMENT?

- YES
- NO → PROPOSED INCREASE IN IMPERVIOUS COVER

PROPOSED INCREASE IN IMPERVIOUS COVER

- ≥400 SF
- <400 SF → **TYPE I DEVELOPMENT**

PROPOSED INCREASE IN IMPERVIOUS COVER

- >1,000 SF → **TYPE III DEVELOPMENT**
- ≤1,000 SF → ≤1,000 SF ADDITIONAL IMPERVIOUS COVER

≤1,000 SF ADDITIONAL IMPERVIOUS COVER

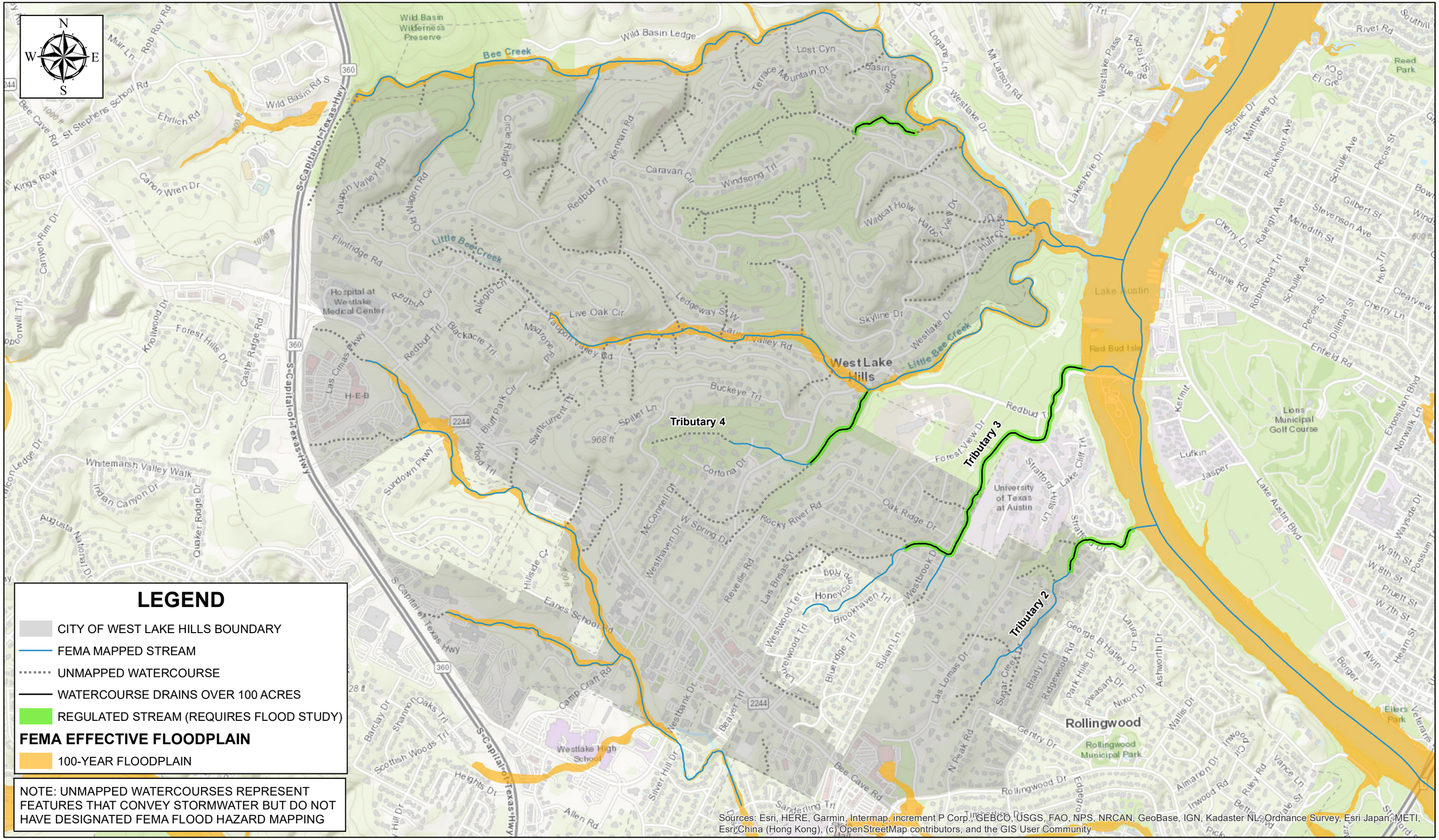
- IMPERVIOUS COVER PERCENTAGE OF TOTAL SITE, NOT JUST PROPOSED IMPROVEMENTS
- DISTURBED AREA OF TOTAL SITE

IMPERVIOUS COVER PERCENTAGE OF TOTAL SITE, NOT JUST PROPOSED IMPROVEMENTS

- >30% → **TYPE III DEVELOPMENT**
- ≤30% → **TYPE II DEVELOPMENT**

DISTURBED AREA OF TOTAL SITE

- ≤1/8 AC → **TYPE II DEVELOPMENT**
- >1/8 AC → **TYPE III DEVELOPMENT**



APPENDIX C: CITY OF WEST LAKE HILLS WATERCOURSE EXHIBIT

2.1 Permit Submittal Components

The submittal components to be provided by the property owner, or agent, are determined by the requirements of this manual. Applications are also located on the City's website.

The development category shall be based on the type of development, impervious cover, and disturbed area of the development as shown in Table 2-1 and Table 2-2. The development category for an application shall be determined by the least restrictive category where all the criteria are met.

Table 2-1: Residential Development Categories

Category	Criteria
Residential Type I Development (Type I-R)	No work within public easements; and > 100-feet of a FEMA designated floodplain; and ≤ 400 SF of additional impervious cover within the past five years; or No work within public easements; and > 100-feet of a FEMA designated floodplain ~~or regulated stream shown in Appendix C~~; and <20% total site impervious cover; and < 1,000 SF of additional impervious cover within the past 5 years
Residential Type II Development (Type II-R)	≥ 1,000 SF of additional impervious cover; or ≥ 20% total site impervious cover; or < 100-feet of a FEMA designated floodplain or regulated stream shown in Appendix C

Table 2-2: Non-Residential Development Categories

Category	Criteria
Non-Residential Type I Development (Type I-C)	No Variances/Special Use Permits; and No work within easement; and > 100-feet of a FEMA designated floodplain or regulated stream shown in Appendix C; and < 400 SF of additional impervious cover
Non-Residential Type II Development (Type II-C)	≤ 1,000 SF of additional impervious cover; and ≤ 30% total impervious cover; or ≤ 1/8 ac disturbed area
Non-Residential Type III Development (Type III-C)	> 30% total impervious cover; or > 1/8 ac disturbed area; or > 1,000 SF of additional impervious cover; or < 100 feet of a FEMA designated floodplain or regulated stream shown in Appendix C

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If any existing onsite or offsite stormwater infrastructure related to the development is known to be at or above design capacity, the development will be considered a Type II (Residential) and a Type III Development (Non-residential). The submittal and drainage report requirements are outlined below. Submittal requirements are included ~~on~~with the applications available from the City.

2.1.6 IMPERVIOUS COVER

The table below outlines impervious cover restrictions for Building Rules and Drainage Mitigation. For water quality purposes, permeable concrete and pavers are treated as impervious surfaces when calculating Total Suspended Solids (TSS) load reduction and sizing Best Management Practices. Permeable concrete is permitted within the contributing zone; however, its use in the recharge zone is not currently authorized. For additional guidance on impervious cover limitations, consult the most recent edition of TCEQ Report Publication RG-348.

Residential development submittals must include two impervious cover tables: one addressing Building Rules and Drainage Mitigation titled "City of West Lake Hills Impervious Cover Table" and a second for water quality determination. The water quality table should be titled "Impervious Cover for Water Quality – Edwards Aquifer Recharge Zone" or "Impervious Cover for Water Quality – Edwards Aquifer Contributing Zone," as applicable.

Table 2-3: City of West Lake Hills Impervious Cover Table

Category	Criteria
100% Impervious	• Buildings and other Structures • Parking areas, roads, streets, driveways, and compacted road base. • Any other manmade areas of asphalt, impermeable concrete, compacted base material, pavers, or other impervious material. • Permeable concrete or pavement/pavers WITHOUT a *proper underdrain. • Infinity pools or pools with less than 6" of freeboard.
50% Impervious	• Wooden or composite decks with natural ground underneath and 0.25" gap width in between. • Crushed granite and/or gravel pathways installed over a ~~Mirafi (140N)~~ geotextile fabric with a minimum 2-inch sand bedding layer and with proper edging to prevent erosion during a rain event. o ~~Cannot exceed 20% of front yard, m~~Maximum width of 3-foot. o ~~Cannot exceed 20% of back yard.~~ • Artificial turf in the backyard only, WITH a ~~*~~proper underdrain* and limited to ~~25% of~~ landscape area in the backyard.
0% Impervious	• Permeable concrete or pavement/pavers WITH a ~~*~~proper underdrain*. • Pools with at least 6" of freeboard on all sides • Manmade areas of loose rock or stone (3/4~~2~~"-8" diameter, i~~I~~f the rock gradation exceeds 8", the impervious coverage will be 50%.) to be used as landscaping features that: o Does not have a compacted base; and o Are not used for the conveyance or storage of vehicles, machinery or equipment; and o Are sufficiently contained by edging to prevent erosion during a rain event. • 12" Masonry retaining walls, up to 200 linear feet allowed • Eaves and overhangs which are over two feet above the natural grade and projecting from the building no more than two feet.

*Proper underdrain: System designed to accommodate a 10-year storm.

Note: All other materials are subject to approval by City Staff/City Engineer

ORDINANCE NO. 2026-003

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF WEST LAKE HILLS, TEXAS, AMENDING THE CODE OF ORDINANCES SECTION 1.01.003 DEFINITIONS – IMPERVIOUS COVER AND ARTICLE 22.03 CONSTRUCTION CODE; REPEALING ALL ORDINANCES TO THE EXTENT THEY ARE IN CONFLICT; PROVIDING FOR SEVERABILITY; AND PROVIDING AN EFFECTIVE DATE

WHEREAS, the City of West Lake Hills, Texas ("City") is a general law municipality operating under the laws of the State of Texas; and

WHEREAS, pursuant to Texas Local Government Code Section 51.001, the City has general authority to adopt an ordinance that is for the good government, peace or order of the City and is necessary or proper for carrying out a power granted by law to the City; and

WHEREAS, pursuant to Chapter 211 and 212 of the Texas Local Government Code, the City has adopted the Drainage and Erosion Control Design Manual (DECDM) to provide adequate drainage in a subdivision in accordance with standard engineering practices; and

WHEREAS, Section 20.02.005 of the Code of Ordinances ("the Code") establishes the adoption of the Drainage and Erosion Control Design Manual; and

WHEREAS, a drainage review focus group was created in 2024 to recommend amendments to the Drainage and Erosion Control Design Manual; and

WHEREAS, ZAPCO held a public hearing on March 18, 2026 and, following such hearing, provided its recommendation to the City Council; and

WHEREAS, on April 8, 2026, the City Council conducted a public hearing and, after consideration, determined that the ordinance amendment be approved as provided herein; and

WHEREAS, the City Council finds that the amendment proposed is reasonable, necessary, and proper for the good government of the City of West Lake Hills.

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF WEST LAKE HILLS, TEXAS THAT:

SECTION 1. The foregoing recitals are found to be true and correct legislative and factual findings of the City Council and are hereby approved and incorporated into the body of this Ordinance.

SECTION 2. This Ordinance is adopted under the authority of the Constitution and laws of the State of Texas, particularly Chapter 211 and 212 of the Local Government Code.

SECTION 3. Section 1.01.003 Definitions – Impervious Cover and Article 22.03 Construction Code -Section 22.03.059 Drainage and erosion control manual are hereby amended as set forth in **Exhibit A** attached hereto and incorporated into this Ordinance for all intents and purposes.

SECTION 4. If any provision of this Ordinance is illegal, invalid, or unenforceable under present or future laws, the remainder of this Ordinance will not be affected and, in lieu of each illegal, invalid, or unenforceable provision, a provision as similar in terms to the illegal, invalid, or unenforceable provision as is possible and is legal, valid, and enforceable will be added to this Ordinance.

SECTION 5. This Ordinance shall be cumulative of all provisions of ordinances of the City except where the provisions of the Ordinance are in direct conflict with the provisions of such ordinances, in which event the conflicting provisions of such ordinances are hereby repealed.

SECTION 6. This Ordinance shall be construed and enforced in accordance with the laws of the State of Texas and the United States of America.

SECTION 7. It is officially found, determined, and declared that the meeting at which this Ordinance is adopted was open to the public as required and that public notice of the time, place, and purpose of said meeting was given as required by the Texas Open Meetings Act, Chapter 551, Texas Local Government Code, as amended.

SECTION 8. This Ordinance shall be in full force and effect after its final passage and approval by the City Council, as duly attested by the Mayor and City Secretary, and any publication required by law.

PASSED and **APPROVED** this 8th day of April, 2026.

CITY OF WEST LAKE HILLS, TEXAS

By: _____
James Vaughan, Mayor

ATTEST:

_____
Makayla Rodriguez, City Secretary

§ 1.01.003. Definitions and rules of construction.

In the construction of this code and of all ordinances passed by the city council, the following definitions and rules of construction shall be observed, unless such construction would be inconsistent with the manifest intent of the council. Words used in this code and not defined in this section shall have their ordinarily accepted meaning.

Impervious cover. See Drainage and Erosion Control Design Manual Section 2.1.6 ~~Manmade or constructed coverage of the natural ground with any structure or surface that impedes, inhibits or does not permit the absorption or passage of water into the ground or which results in the conveyance of excess water to the surrounding properties.~~

~~(1) Items that are considered to be 100% impervious include, but are not limited to:~~

~~(A) Buildings and other structures;~~

~~(B) Parking areas, roads, streets and driveways; and~~

~~(C) Any other manmade areas of asphalt, impermeable concrete, compacted base material, pavers or other impervious material.~~

~~(2) Items that are considered to be 75% impervious include, but are not limited to: permeable concrete or pavement that is demonstrated by a certified engineer to minimize water runoff to adjacent areas and maximize absorption and filtration through the permeable material. Property owners wishing to use items which the property owner wishes to be calculated as 75% impervious cover shall apply for and receive approval from the city administrator prior to installation.~~

~~(3) Items that are considered to be 50% impervious include, but are not limited to:~~

~~(A) Wooden or composite decks with gaps between the plants to allow the passage of water to the natural, permeable ground surface below the deck;~~

~~(B) Manmade areas of loose rock or stone to be used as landscaping features that:~~

~~(i) Do not have a compacted base;~~

~~(ii) Are not used for the conveyance or storage of vehicles, machinery or equipment;~~

~~(iii) Are not located in the setbacks; and~~

~~(iv) Are sufficiently contained by edging to prevent erosion during a rain event.~~

~~(v) Items that are not considered to be impervious include overhangs and eaves which are over two (2) feet above the natural grade and projecting from the building no more than two (2) feet.~~

ARTICLE 22.03
CONSTRUCTION CODE

DIVISION 1
Generally

§ 22.03.001. Definitions.

Impervious cover. See ~~section 1.01.003~~ Drainage and Erosion Control Design Manual.

City of West Lake Hills

Drainage and Erosion Control Design Manual

REVISION X.X. EFFECTIVE MONTH DAY, 2026

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CHAPTER 1 INTRODUCTION

The purpose of the Drainage and Erosion Control Design Manual is to establish standard principles and practices for the planning, design, construction, maintenance, and management of stormwater drainage, erosion control, and water quality facilities within the City of West Lake Hills and its ETJ. The policy statements of Chapter 2 provide the underlying principles by which all drainage facilities shall be designed. The application of the policy is facilitated by the technical criteria contained in the remainder of the manual.

1.1 Purpose and Scope

The design factors, formulas, graphs, and procedures described in this manual are intended to serve as guidelines for the design of drainage improvements and projects involving the volume, rate of flow, method of collection, storage, conveyance, treatment, and disposal of stormwater and erosion protection from stormwater flows. Responsibility for actual design remains with the design engineer.

This manual and the City of West Lake Hills Code of Ordinances (City Code) contain requirements for the design of infrastructure related to storm drainage, flood protection, water quality, and erosion control facilities. Where there is any conflict between this manual and the current City Code, the more restrictive shall take precedence. The design engineer is responsible for complying with the latest version of this manual and code adopted by the City.

If conflicts occur between City policy and criteria in this manual versus other regulatory authorities with jurisdiction in the same area, such as TCEQ, FEMA, or TxDOT, then the more stringent requirement will apply. Where applicable, other jurisdictional reviews may also be required in addition to that of the City.

1.2 Applicability

Stormwater policy and criteria in this manual shall apply to all drainage improvements and projects that may impact drainage or water quality, both publicly and privately funded, within the City and within its ETJ. Definitions, methods, criteria, procedures, and data in this manual have been developed to support the stormwater policy outlined in Chapter 2.

1.3 Waivers

The City Administrator, when petitioned for a waiver, may approve the waiver, deny the waiver, or make an initial determination and refer the matter to City Council for a variance. If the City Administrator approves the waiver, no additional approval by the City Council is needed.

1.4 Amending the Manual

Amendments may be recommended by City Staff and approved, denied, or sent to City Council by the City Administrator. Notification and explanation shall be given to the City Council of all administratively approved amendments. Any member of the City Council may request that the administratively approved amendment be placed on a City Council meeting agenda for discussion and review. If a request for an administratively approved amendment to be placed on a City Council agenda is not received within ten days, the administratively approved amendment will immediately take effect.

1.5 References and Definition of Terms

At certain points in the text, the reader will encounter numbers enclosed in brackets, for example [1]. These numbers correspond to the references listed in Appendix A. Definitions of common terms used in this manual are provided in Appendix B. A list of abbreviations commonly used within this manual is in Table 1-1. For unfamiliar abbreviations not included in Table 1-1, the City of West Lake Hills may be contacted for the appropriate full, formal name associated with the abbreviation.

Table 1-1: List of Abbreviations

Abbreviation	Definition
AASHTO	American Association of State Highway and Transportation Officials
BMP	Best Management Practice
City	City of West Lake Hills
ETJ	Extraterritorial Jurisdiction
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Association
NRCS	Natural Resources Conservation Service
ROW	Right-of-way
TCEQ	Texas Commission on Environmental Quality
TPDES	Texas Pollutant Discharge Elimination System
TxDOT	Texas Department of Transportation
USACE	US Army Corps of Engineers

CHAPTER 2 DRAINAGE CRITERIA

This manual represents the application of accepted principles of surface drainage engineering and is a working supplement to information obtainable from standard drainage design handbooks, other publications on drainage design, and the City Code. The policy statements of this section provide the underlying principles by which all drainage improvements shall be designed. The application of the policy is facilitated by the technical criteria contained in the remainder of the manual.

2.1 Permit Submittal Components

The submittal components to be provided by the property owner, or agent, are determined by the requirements of this manual. Applications are also located on the City's website.

The development category shall be based on the type of development, impervious cover, and disturbed area of the development as shown in Table 2-1 and Table 2-2. The development category for an application shall be determined by the least restrictive category where all the criteria are met.

Table 2-1: Residential Development Categories

Category	Criteria
Residential Type I Development (Type I-R)	No work within public easements; and > 100-feet of a FEMA designated floodplain or regulated stream shown in Appendix C; and <20% total site impervious cover; and < 1,000 SF of additional impervious cover within the past 5 years
Residential Type II Development (Type II-R)	≥ 1,000 SF of additional impervious cover; or ≥ 20% total site impervious cover; or < 100-feet of a FEMA designated floodplain or regulated stream shown in Appendix C

Table 2-2: Non-Residential Development Categories

Category	Criteria
Non-Residential Type I Development (Type I-C)	No Variances/Special Use Permits; and No work within easement; and > 100-feet of a FEMA designated floodplain or regulated stream shown in Appendix C; and < 400 SF of additional impervious cover
Non-Residential Type II Development (Type II-C)	≤ 1,000 SF of additional impervious cover; and ≤ 30% total impervious cover; or ≤ 1/8 ac disturbed area
Non-Residential Type III Development (Type III-C)	> 30% total impervious cover; or > 1/8 ac disturbed area; or > 1,000 SF of additional impervious cover; or < 100-feet of a FEMA designated floodplain or regulated stream shown in Appendix C

If any existing onsite or offsite stormwater infrastructure related to the development is known to be at or above design capacity, the development will be considered a Type II (Residential) and a Type III Development (Non-residential). The submittal and drainage report requirements are outlined below. Submittal requirements are included on the applications available from the City.

2.1.1 PRELIMINARY DRAINAGE PLAN

A Preliminary Drainage Plan of the drainage system is required with preliminary plats. A Preliminary Drainage Plan may be required with a zoning, rezoning, special use permit or planned development plan applications.

A Preliminary Drainage Plan shall at a minimum provide the following information:

- Map existing and proposed flow paths.
- Show locations of channels, storm sewers, detention structures, floodplain, floodway, and associated drainage easements.
- Show how runoff will be conveyed safely through the site.
- Provide preliminary hydrologic calculations to show expected runoff volumes and peak flows.
- Provide preliminary hydraulic calculations to verify sizing of public facilities.
- Demonstrate that downstream conditions have been considered and will not be negatively impacted.
- A technical memo describing the site's overall stormwater management approach, including the intended conveyance, storage, and discharge strategies. The narrative shall identify existing drainage constraints, potential design challenges, and any additional analyses or studies required to confirm feasibility.

2.1.2 TYPE I DEVELOPMENT SUBMITTAL FOR RESIDENTIAL AND NON-RESIDENTIAL DEVELOPMENT

A Type I Development is for use with small-scale residential and non-residential improvements including remodeling, renovations, or minor additions. Criteria for Type I application is illustrated in Section 2.1. The submittal shall include all items on a complete application. Reference Checklist for Type I Residential & Non-Residential Development.

2.1.2.1 Type I Drainage Memo

A Type I Drainage Memo shall be prepared by the property owner or its agent and provide, at a minimum, the following information:

- Applicant contact information (e.g. name, address, phone number, and email address)
- Site location map
- Description of the existing drainage patterns and description of proposed alterations; and
- Temporary erosion control plan

2.1.3 TYPE II DEVELOPMENT SUBMITTAL FOR RESIDENTIAL DEVELOPMENT

A Type II Development is for use with standard and large-scale residential improvements. The submittal shall include all items on a complete application and shall be prepared by the agent. Reference Checklist for Type II Residential Development.

2.1.3.1 Type II Drainage and Water Quality Report

A Type II Drainage and Water Quality Report shall be prepared, signed and sealed by a professional engineer licensed in the State of Texas, experienced in civil engineering.

The Type-II drainage report at the minimum should include verbiage regarding the planning and design of drainage systems and should ensure that the project does not impact properties upstream and downstream of the subject property. Construction activities such as on-site grading, should ensure the proposed improvements are constructed with minimal impacts to the existing grade and should avoid sediment movement and erosion. The proposed improvements should not exacerbate flooding downstream, and excess runoff shall be mitigated on site.

Property owners are responsible for resolving drainage concerns within developed lots. The developer shall be responsible for pre-development and post-development flow conditions, with-in and adjacent to the subject property, including pre-existing drainage concerns. The developer shall protect/conserve natural flow courses and ensure unobstructed conveyance of storm water entering and leaving the site. As part of a Type II submittal package, drainage computations shall be provided to verify no adverse

impact upstream or downstream, which is further illustrated in Chapter 7 *Adverse Impact Analysis*.

Proposed improvements, such as on-site grading and/or addition or removal of impervious areas shall ensure that post-development flows are equal to or less than pre-development flows. Downstream capacity shall typically not be exceeded as a result of development. However, in cases where the capacity exceeds, the developer shall upgrade the current drainage infrastructure to ensure system has adequate capacity to handle the increase in flows. Additional drainage improvements are not required if the current drainage system has adequate capacity for the fully developed condition; as long as the assumptions made (for the proposed site) in the fully developed calculations, matches with the current proposed development.

The report should contain, at a minimum, the following information:

- Description of project's geographic location, with respect to the watershed, streets, political boundaries, and other adjacent landmarks.
  At a minimum include a location exhibit and a USGS exhibit, indicating the site's location.
- FEMA defined floodplain information adjacent to the site, including but not limited to: name of the flooding source, Flood Insurance Rate Map Panel Number, type of floodplain designation (Zone A, AE, X, etc.), approximate date of the flood study, approximate date of topographic data used for the flood study and flood mapping; distance from the FEMA Effective Floodplain, type of software used to develop the Effective flood models, methodology used to develop the Effective flood models, peak flows used in the models, etc. Additionally, show the site boundary overlaid on a FEMA firmette or FIRM panel.
- If best available data such as topography, rainfall, and/or other significant Hydrologic or Hydraulic (H&H) parameters supersedes the data used in the Effective models; then the H&H models will need to be updated, and the drainage report shall be updated with the resulting floodplain mapping.
- Edwards Aquifer zone designation.
- Description of the existing drainage patterns and description of proposed alterations.
- Description of all proposed improvements including buildings, roadways, and drainage infrastructure.
- Drainage Area maps with a minimum of 1-foot contours, with associated labels. Maps should also include flow path delineations with associated flow path classification. The map shall identify the point downstream of the site as "Point of Analysis 1" and identify the zone of influence point based on the 10% drainage rule, as "Point of Analysis 2". Identify centroids of the sub-basins if needed for the analysis.
- Description and calculation of impervious cover, including a comparison between existing/pre-development and post-development conditions.
- For larger watershed, use the best available aerial imagery to delineate and categorize developed areas to calculate an area-weighted average for each sub-basin.
- Soil classification maps, with appropriate soil parameters such as curve numbers or similar.
- Provide a table showing the rainfall data used for the study, along with the source of the data
- Provide a hydrologic summary as input and output tables and include hydrologic calculations for all conditions analyzed for the 5-, 25-, and 100-year storm events.
- Hydraulic calculations for all existing and proposed natural and engineered conveyance systems shall be performed using a recent version of HEC-RAS; and
- Provide a hydraulic summary table with the flow, water surface elevation and velocity associated with each of the cross sections used in the hydraulic models and provide comparison tables between existing, proposed and any other relevant scenarios.
- Description and calculations for hydrologic or hydraulic mitigation.
- For FEMA applications, include all items required by FEMA, such as MT-2 forms, Annotated FIRM,

Endangered Species Assessment (for CLOMRs), draft property owner notifications, as-built field survey (for LOMRs) etc.

2.1.4 TYPE II DEVELOPMENT SUBMITTAL FOR NON-RESIDENTIAL DEVELOPMENT

A Type II Development is for use with small-scale non-residential projects. The submittal shall include all items on a complete application. Reference Checklist for Type II Non-Residential Development.

2.1.4.1 Type II Drainage Report

A Type II Drainage Report shall be prepared, signed and sealed by a professional engineer licensed in the State of Texas, experienced in civil engineering, and having a thorough knowledge of hydraulic analysis and design.

The report shall contain, at a minimum, the following information:

- Description of the existing drainage patterns and description of proposed alterations;
- Hydrologic calculations for each condition analyzed for the 5-, 25-, and 100-year storm events; and
- Description and required calculations for hydrologic or hydraulic mitigation.

2.1.5 TYPE III DEVELOPMENT SUBMITTAL FOR NON-RESIDENTIAL DEVELOPMENT

A Type III Development is for use with large-scale residential and standard non-residential improvements. The submittal shall include all items on a complete application and shall be prepared by the agent. Reference Checklist for Type III Non-Residential Development.

2.1.5.1 Type III Drainage and Water Quality Report

A Type III Drainage and Water Quality Report shall be prepared, signed and sealed by a professional engineer licensed in the State of Texas, experienced in civil engineering, and having a thorough knowledge of hydraulic analysis and design.

The planning and design of drainage systems should ensure that problems are not transferred from one location to another. Grading and other construction activities may not change the terrain in such a way to cause damage to public or private property from drainage or flood problems, increased runoff, or increased erosion or sediment movement.

Existing drainage between developed lots will remain the responsibility of the affected property owners. The developer shall be responsible for the conveyance of all storm drainage flowing through or abutting the subject property, including drainage directed to the property by prior development as well as that naturally flowing by reason of topography. Therefore, drainage computations shall be provided to verify no adverse impact upstream or downstream.

Proposed construction, platting or other development where the proposed activity or change in the land shall not result in post development discharge from the site exceeding discharge under pre-developed conditions (for new development) or existing conditions (for re-development). Downstream capacity shall not be exceeded as a result of development. Additional drainage improvements are not required if drainage improvements have been provided for the fully developed condition, which includes the proposed development.

The report should contain, at a minimum, the following information:

- Description of project location including indication of FEMA defined floodplain zone and Edwards Aquifer zone designation. A copy of the current FEMA floodplain should be provided with the project location indicated;
- Description of the existing drainage patterns and description of proposed alterations;
- Description of all proposed improvements including buildings, roadways, and drainage

infrastructure;

- Description and calculation of impervious cover, including a comparison between existing/pre-development and post-development conditions;
- Drainage area maps for all conditions analyzed;
- Hydrologic calculations for all conditions analyzed for the 5-, 25-, and 100-year storm events;
- Hydraulic calculations for all existing and proposed conveyance systems; and
- Description and calculations for hydrologic or hydraulic mitigation.

2.1.6 IMPERVIOUS COVER

The table below outlines impervious cover restrictions for Building Rules and Drainage Mitigation. For water quality purposes, permeable concrete and pavers are treated as impervious surfaces when calculating Total Suspended Solids (TSS) load reduction and sizing Best Management Practices. Permeable concrete is permitted within the contributing zone; however, its use in the recharge zone is not currently authorized. For additional guidance on impervious cover limitations, consult the most recent edition of TCEQ Report Publication RG-348.

Residential development submittals must include two impervious cover tables: one addressing Building Rules and Drainage Mitigation titled "City of West Lake Hills Impervious Cover Table" and a second for water quality determination. The water quality table should be titled "Impervious Cover for Water Quality – Edwards Aquifer Recharge Zone" or "Impervious Cover for Water Quality – Edwards Aquifer Contributing Zone," as applicable.

Table 2-3: City of West Lake Hills Impervious Cover Table

Category	Criteria
100% Impervious	• Buildings and other Structures • Parking areas, roads, streets, driveways, and compacted road base. • Any other manmade areas of asphalt, impermeable concrete, compacted base material, pavers, or other impervious material. • Permeable concrete or pavement/pavers WITHOUT a *proper underdrain. • Infinity pools or pools with less than 6" of freeboard.

50% Impervious	• Wooden or composite decks with natural ground underneath and 0.25" gap width in between.
	• Crushed granite and/or gravel pathways installed over a Mirafi (140N) geotextile fabric with a minimum 2-inch sand bedding layer and with proper edging to prevent erosion during a rain event.
	  ○ Cannot exceed 20% of front yard, maximum width of 3-foot.
	  ○ Cannot exceed 20% of back yard.
	• Artificial turf in the backyard only, WITH a *proper underdrain and limited to 25% of landscape area in the backyard.

0% Impervious	• Permeable concrete or pavement/pavers WITH a *proper underdrain.
	• Pools with at least 6" of freeboard on all sides
	• Manmade areas of loose rock or stone (2"-8" diameter, If the rock gradation exceeds 8", the impervious coverage will be 50%.) to be used as landscaping features that:
	  ○ Do not have a compacted base; and
	  ○ Are not used for the conveyance or storage of vehicles, machinery or equipment; and
	  ○ Are sufficiently contained by edging to prevent erosion during a rain event.
	• 12" Masonry retaining walls, up to 200 linear feet allowed

***Proper underdrain: System designed to accommodate a 10-year storm.**

Note: All other materials are subject to approval by City Staff/City Engineer.

2.2 Finished Floor Elevations

Buildings and structures shall have the lowest floor elevated to or above the base flood elevation as prescribed in the City Code Chapter 26. Finished grades shall be sloped to direct stormwater away from the structure. Developments adjacent to stormwater conveyance must be elevated above the 100-year water surface elevation (in the conveyance feature) to the same elevation that a development adjacent to a 100-year floodplain would be required to meet. Conveyance features are included in Appendix C.

2.3 Drainage Facility Design

Drainage patterns should be designed to prevent erosion, maintain filtration and recharge of local seeps and springs, and attenuate the harm of contaminants collected and transported by storm water. Overland sheet flow and natural drainage features and patterns shall be maintained to the greatest extent reasonably possible and the dispersion of runoff back to sheet flow shall be the primary objective of drainage design where possible, depending on volumes and velocities of runoff for the development, as opposed to concentrating flows in storm sewers and drainage ditches. The City requires preservation of the natural floodplains. The protection of existing trees and vegetation should be maximized during development of drainage plans.

Where new drainage improvements are required along the boundary of a site, the owner proposing development shall be responsible for designing and constructing all the required improvements at or before the time of development, including the dedication of all ROW or easements necessary to accommodate the improvements. Where the developer proposes to develop only a portion of the property, only the drainage improvements for the portion being developed shall be required to be installed, except as drainage improvements are necessary for proper drainage of the developed portion. All drainage facilities shall be designed to intercept and transport runoff from a 25-year storm event. The drainage system shall be designed to convey those flows greater than a 25-year storm event, up to and including a 100-year storm event within defined ROW or drainage easements.

Computations to support all drainage designs shall be submitted to the City for review in an easy to follow format. Onsite pre-development stormwater runoff computations shall be based upon conditions representing the existing land conditions with respect to soil type, percentage cover, and cover type as indicated by current aerial imagery and supporting documentation. Design of structures shall use fully developed conditions for the prescribed design storms based on the zoning and/or land use
Modeling and calculations shall be included in drainage report submittals to ensure the specified criteria are met for all drainage infrastructure improvements. Infrastructure that is within TxDOT ROW and requires dual permitting from both the City and TxDOT shall be designed in compliance with the more conservative requirements.

2.3.1 Stream Bank Erosion Hazard Drainage Easements

Erosion hazard drainage easement determination is necessary for the banks of streams in which the natural channel is to be preserved. The purpose of the drainage easement is to reduce the amount of structural damage and stream degradation caused by the erosion of the bank. With the application of stream bank erosion hazard drainage easements, an easement is dedicated to the City such that no structure can be located, constructed, or maintained in the area encompassing the erosion hazard drainage easement. Stream bank erosion hazard drainage easement setback distances are shown in Table 2-4. The City allows for stream bank stabilization as an alternative to dedicating the erosion hazard zone as described in Section 7.4.2.

Table 2-4: Stream Bank Erosion Hazard Drainage Easement Setbacks

Contributing Drainage Area (acres)	Drainage Easement Setback Distance from Stream Centerline (feet)
0 – 320	0
320 - 640	25
640 or more	50

2.3.2 Temporary Erosion Control

Temporary water quality BMPs shall be required when disturbance could result in erosion that could transport or cause accumulation of sedimentation in dedicated streets, alleys, any waterway, or other private properties during construction activities. Temporary and permanent erosion control requirements are provided in Chapter 7.

2.3.3 Drainage Easements and Right-of-Way

Public drainage easements shall include all natural and manmade drainage ways at least to the limits of the 100-year flood as indicated on the floodplain maps or as determined on the basis of the Drainage and Erosion Control Design Manual and drainage infrastructure necessary to serve public right-of-way. Drainage easements are required for detention and water quality facilities for subdivision and joint detention basins. Easement boundaries shall contain the berms, inlet and outlet structures, access ramps, permanent erosion control facilities, the 100-year water surface, and any additional area needed for access and maintenance. The minimum easement shall be at least 25 feet wide. All drainage easements across private property shall contain the necessary language to permit the required unobstructed water flow, require maintenance of vegetation by the property owner(s), and permit the necessary access by city officials for inspection and repairs.

2.3.4 Freeboard

Freeboard is the vertical distance between the design water surface and the elevation of the drainage facility, such as the top of channel, ditch, or detention pond. Freeboard is intended to provide a factor of safety and prevent the fluctuation of the water surface from overflowing the drainage facility. Freeboard requirements are shown in Table 2-5.

Table 2-5: Freeboard Requirements

Drainage Facility	Frequency	Minimum Freeboard
Street ROW	100-year	None
Channels and creek improvements	25-year	0.5 ft
Detention ponds (see note 1)	100-year	1.0 ft
Detention ponds (privately maintained for one single-family lot)	100-year	None
Bridges and culverts	25-year	See note 2

1 Detention ponds maintained by the City, regional detention ponds, or any other detention pond designed for detention of more than one privately maintained single-family lot.

2 Bridge and culverts shall be analyzed to verify any adverse hydraulic impacts are created.

2.4 Stormwater Mitigation

All proposed construction/development shall be designed such that the project does not cause an adverse impact to adjacent properties, drainage infrastructure, or roadways downstream of the project. Methods to verify no adverse impact include: Mitigation through LID features, downstream drainage infrastructure improvements or detention.

Mitigation through detention, retention, or some other technique must be designed, constructed, and maintained to reduce the post-development peak flow discharge rates to below that of pre-development/existing peak flow discharge rates for the five (5), twenty-five (25), and one- hundred (100) year design storms.

Demonstration that no mitigation is in the best interest of the watershed shall be accomplished by showing no adverse impact due to any increased runoff from the proposed development for the design storms. The property owner, or his/her designee, shall meet with the City to discuss impacts and mitigation options prior to commencing the project.

For stormwater mitigation, the following development conditions shall be analyzed with each adverse impact analysis:

A. Pre-Developed Conditions. Refers to the development condition within the watershed prior to any development. This should be used as the baseline for assessing the impact of all new development.
B. Existing Conditions. Refers to current development conditions in the watershed and on site. This shall be used as the baseline for assessing the impact of redevelopment projects.
C. Proposed Conditions. Refers to existing conditions modified with the proposed project development. This shall be used to assess adverse impact to other properties or drainage systems.
D. Post-Developed Conditions. Refers to the proposed condition modified with mitigation. This shall be used to verify the sizing and method of mitigation for the proposed development.
E. Ultimate Conditions. Refers to the development conditions in which all property within the watershed boundaries are developed per maximum zoning requirements.

2.5 Development in the Floodplain

It is the intent of the City Council that the requirements stated in the City Code Chapter 26 comply with federal requirements pertaining to the FEMA authority concerning flood hazards and the USACE jurisdiction over waters of the United States. A permit shall be required for any lot located within 100 feet of a FEMA designated floodplain or for any portion of the lot located within 100 feet of a FEMA designated floodplain. No person, individual, partnership, firm, or corporation shall deepen, widen, fill, reclaim, reroute or change the course or location of any existing ditch, channel, stream or drainage way without first obtaining a permit from the City and any other applicable agencies having jurisdiction, such as FEMA or the USACE. The City may require preparation and submission of a FEMA study for a proposed development if there are concerns regarding storm drainage on the subject property or upstream or downstream from the subject property. The costs of such study, application, and/or permit, if required, shall be borne by the developer. The current FEMA floodplains and their associated flood sources can be found in Appendix C. Appendix C also includes water courses (conveyance features) that are not currently mapped by FEMA. Regulated streams (water courses that drain over 100 acres) will require a new flood study to establish the 100-year water surface elevations.

2.6 Permanent Water Quality Controls

Development and redevelopment located over the Edwards Aquifer regulatory zones shall comply with the latest TCEQ published rules and technical design guidance for the Edwards Aquifer in accordance with 30 TAC Chapter 213 (Edwards Aquifer Rules). Permanent water quality BMPs for development outside of the Edwards Aquifer regulated zones shall be designed to provide adequate treatment of the water quality volume in the City's jurisdiction as defined in Chapter 6.

2.7 Maintenance of Drainage Facilities

All drainage facilities located in the street ROW except driveway culverts, shall be maintained by the appropriate jurisdiction. The property owner shall maintain all drainage facilities located on private

property including driveway culverts. Authorized inspectors of the City shall have the right of entry on the land or premises where property owners are required to maintain drainage facilities or detention facilities, at reasonable times and after notifying the property owner, for the purpose of inspection of the maintenance.

2.7.1 MAINTENANCE ACCESS

Access shall be provided to all ponds and channel maintained by the City, regional drainage facilities, or any other drainage facility designed for drainage of more than one privately maintained single-family lot as follows: ponds and channels shall provide a maintenance access with a width of at least 12 feet and have a vertical grade no steeper than 6H:1V. Access shall be provided within dedicated ROW or within the drainage easement and shall be clearly identified on plans.

Maintenance schedules and descriptions of maintenance practices for privately maintained single-family residential ponds and channels shall be provided within the plans or as a separate document. Adequate access shall be provided for the maintenance description provided.

CHAPTER 3 DETERMINATION OF STORM RUNOFF

3.1 General Requirements

The selection of the appropriate method for calculating runoff depends upon the size of the drainage area, time of concentration, and detention mitigation. Flows are to be analyzed for both existing and proposed conditions at all locations where runoff leaves a proposed project for the5-, 25-, and 100- year frequencies. Design discharges are to be calculated by either the Rational Method or the NRCS Unit Hydrograph Method.

The Rational Method is accepted as adequate for drainage areas totaling 200 acres or less with no detention or timing considerations. The National Resources Conservation Service hydrologic methods should be used for drainage areas larger than 200 acres but may also be used for drainage areas of any size. The method of analysis must remain consistent when drainage areas are combined and the method that applies to the largest combined drainage area should be used.

3.2 Design Rainfall

Rainfall, along with watershed characteristics, determines the storm runoff flows upon which storm drainage design is based.

3.2.1 Rainfall Intensity Duration Frequency

Intensity-Duration-Frequency curves provide a summary of a site's rainfall characteristics by relating storm duration and storm frequency to rainfall intensity. The Intensity-Duration-Frequency curve parameters, included in Table 3-1, from the City of Austin DCM shall be used.

Table 3-1: Intensity Duration Frequency Parameters

Return Period	a	b	c
2	45.24	9.339	0.7399
10	61.25	8.352	0.7147
25	69.96	7.941	0.6954
100	77.31	6.832	.6524
500	77.48	4.967	0.5837

3.2.2 Rainfall Depth Duration Frequency

The appropriate rainfall depths for calculations in the City are provided in Table 3-2. These are estimated from analysis performed for rainfall data available in the State of Texas. [1]

Table 3-2: Depth-Duration-Frequency (inches)

Duration	Return Period				
	2-year	10-year	25-year	100-year	500-year
5 min	0.53	0.80	0.98	1.28	1.68
15 min	1.06	1.60	1.96	2.54	3.34
30 min	1.49	2.25	2.75	3.54	4.69
1 hr	1.96	2.99	3.66	4.77	6.45
2 hr	2.42	3.82	4.81	6.57	9.27
3 hr	2.70	4.34	5.55	7.81	11.31
6 hr	3.17	5.21	6.78	9.79	14.48
12 hr	3.64	6.02	7.85	11.37	16.94
24 hr	4.14	6.84	8.90	12.80	19.05

3.3 The Rational Method

The Rational Method is appropriate for estimating peak discharge in basins that do not require detention or timing considerations. The method is based on the direct relationship between rainfall and runoff and is given by the following relationship (Equation 3-1):

$$Q=k(ciA) \quad \text{(Equation 3-1)}$$

Where:

Q = peak runoff (cfs)
k = Antecedent Precipitation Coefficient (Table 3-3)
c = Runoff Coefficient (Table 3-4)
i = Average rainfall intensity (in/hr)
A= Drainage area (ac)

Table 3-3: Antecedent Precipitation Coefficient (k)

Frequency	k
2 year	1.00
10 year	1.00
25 year	1.10
100 year	1.25

The Rational Method equation is based on the following assumptions:

- Rainfall intensity is constant over the time it takes to drain the watershed (time of concentration)
- The runoff coefficient remains constant during the time of concentration
- The watershed area does not change
- The minimum time of concentration is not less than 10 minutes and does not exceed 3-hours

3.3.1 Runoff Coefficient

Suggested runoff coefficients (c) with respect to specific surface types are given in Table 3-4. The runoff coefficients include an antecedent precipitation factor to reflect the additional runoff that results from saturated ground conditions with less frequent recurrence intervals. The City must approve assumptions for fully developed conditions where maximum allowable impervious cover is not defined by City Code. Runoff coefficients for developed conditions should be based on composite values given by Equation 3-2.

$$c = \mathrm{I}c_{\mathrm{i}} + (1 - \mathrm{I})c_{\mathrm{p}} \quad \text{(Equation 3-2)}$$

Where:

c = Composite runoff coefficient
I = Impervious cover (%)
c_i = Runoff coefficient for impervious cover
c_p = Runoff coefficient for pervious cover

Table 3-4: Runoff Coefficient (c)

Surface (Developed)			c	Area (Undeveloped)	c
Pavement				Cultivated	
Asphaltic			0.81	Flat, 0-2%	0.36
Concrete			0.83	Average, 2-7%	0.41
Grass (Lawn, Parks)				Steep, over 7%	0.44
Condition	Poor	Fair	Good	Pasture/Range	
Flat, 0-2%	0.37	0.30	0.25	Flat, 0-2%	0.30
Average, 2-7%	0.43	0.38	0.35	Average, 2-7%	0.38
Steep, over 7%	0.45	0.42	0.40	Steep, over 7%	0.42
"Poor" consists of less than 50 percent coverage.				Forest/Woodlands	
"Fair" consists of between 50 and 75 percent coverage.				Flat, 0-2%	0.28
"Good" consists of greater than 75 percent coverage.				Average, 2-7%	0.36
				Steep, over 7%	0.41

3.3.2 TIME OF CONCENTRATION

The time of concentration is the time for surface runoff to flow from the most hydraulically remote point in the drainage basin to the drainage point of interest. The most hydraulically remote point refers to the route requiring the longest drainage travel time and not necessarily the greatest linear distance. Furthermore, the most hydraulically remote point must be taken from a location that best represents the majority of the contributing area.

The preferred procedure for estimating time of concentration is the Natural Resources Conservation Services (NRCS) method as described in Technical Release 55 [2]. This method is outlined below. The time of concentration to any point in a storm drainage system is the sum of the sheet flow (overland), the shallow concentrated flow, and the channel flow, which may include storm drains. Note that there may be multiple shallow concentrated and channel segments depending on the nature of the flow path. The minimum time of concentration for any drainage area shall be 10 minutes.

Sheet Flow

Sheet flow is shallow flow over land surfaces, which usually occurs in the headwaters of streams. The engineer should realize that sheet flow occurs for only very short distances, especially in urbanized conditions. Sheet flow for both natural (undeveloped) and developed conditions should be limited to a maximum of 100 feet. Sheet flow for developed conditions should be based on the actual pavement or grass conditions for areas that are already developed and should be representative of the anticipated land use within the headwater area in the case of currently undeveloped areas. In a typical residential subdivision, sheet flow may be the distance from one end of the lot to the other or from the house to the edge of the lot. In some heavily urbanized drainage areas, sheet flow may not exist in the headwater area. The NRCS method employs Equation 3-3, which is a modified form kinematic wave equation, for the calculation of the sheet flow travel time.

$$T_t = \frac{0.42(nL)^{0.8}}{P_2^{0.5}\, s^{0.4}} \qquad \text{(Equation 3-2)}$$

Where:

T_t = Travel time (min)
L = Length of the reach (ft)
n = Manning's coefficient (Table 3-5)
P_2 = 2-year, 24-hour rainfall (in) (Table 3-2)
s = Slope of the ground (ft/ft)

Overland flow

After a maximum of approximately 100 feet, sheet flow usually becomes shallow concentrated flow collecting in swales, small rills, and gullies. Shallow concentrated flow is assumed not to have a well-defined channel and has flow depths of 0.1 to 0.5 feet. The travel time for shallow concentrated flow can be computed by Equation 3-4.

$$T_t = \frac{Ln}{(60s^{0.5})} \quad \text{(Equation 3-3)}$$

Where:

T_t = Travel time (min)
L = Length of the reach (ft)
n = Manning's coefficient (Table 3-5)
s = Slope of the ground (ft/ft)

Table 3-5: Manning's Coefficients for Overland Flow

Surface Description	Manning's Coefficient (n)
Concrete (rough or smoothed finish)	0.015
Asphalt	0.016
Fallow (no residue)	0.050
Cultivated Soils:	
Residue Cover ≤ 20%	0.060
Residue Cover > 20%	0.170
Grass:	
Short-grass prairie	0.150
Dense grasses	0.240
Bermuda Grass	0.410
Range (natural)	0.130
Woods:	
Light Underbrush	0.400
Dense Underbrush	0.800
Source: City of Austin Drainage Criteria Manual [3]	

Channel flow

The velocity in an open channel or a storm drain not flowing full can be determined by using Manning's Equation. Channel velocities can also be determined by using backwater profiles. For open channel flow, average flow velocity is usually determined by assuming a bank-full condition. The channel flow component of the time of concentration may need to be divided into multiple segments in order to represent significant changes in channel characteristics. The details of using Manning's Equation and selecting Manning's coefficient for channels can be obtained from HEC-22. Manning's coefficients for channel flow are located in Table 4-3. For conveyance within storm drains, Manning's coefficients are included in Table 3-6.

Table 3-6: Manning's Coefficients for Closed Conduits

Material	Manning's Coefficient (n)
Asbestos-cement pipe	0.011-0.015
Concrete pipe	0.011-0.015
Concrete box	0.012-0.015
Corrugated metal pipe	0.018-0.026
Polyvinyl chloride (PVC) pipe	0.009-0.011
Source: TxDOT Hydraulic Design Manual [4]	

3.3.3 RAINFALL INTENSITY

Rainfall intensity (i) is the average rainfall rate in inches per hour, and is selected based on design rainfall duration and design frequency of occurrence. The design duration is equal to the time of concentration for the drainage area under consideration. The design frequency of occurrence is a statistical variable that is established by design standards or chosen by the engineer as a design parameter.

The rainfall intensity used in the rational method can be calculated the value of rainfall intensity from the parameters, Table 3-1, and Equation 3-6 with the known Tc value for the entire drainage area.

$$i = \frac{a}{(T_c+b)^c} \quad \text{(Equation 3-6)}$$

3.4 NRCS Unit Hydrograph

The preferred unit hydrograph in general is the NRCS Dimensionless Unit Hydrograph. The runoff curve number used in calculating the existing/pre-development condition and the post-development condition shall be documented. A fully developed drainage area shall be assumed for the post-development condition. Average antecedent moisture conditions II (AMC II) shall be assumed.

3.4.1 CURVE NUMBER

Rainfall infiltration losses depend primarily on soil characteristics and land use (surface cover). The NRCS method uses a combination of soil conditions and land use to assign runoff Curve Numbers. NRCS curve numbers are to be selected from Table 3-7. Note that Curve Numbers are whole numbers. For a watershed that has variability in land cover and soil type, a composite Curve Number is calculated and weighted by area.

Table 3-7: Runoff Curve Numbers

Cover Description	Curve Numbers for Hydrologic Soil Group			
	A	B	C	D
Developed Areas				
Streets and Roads	98	98	98	98
Commercial and business (85% IC)	89	92	94	95
Residential: 1/8 acre or less (65% IC)	77	85	90	92
Residential: 1/4 acre (38% IC)	61	75	83	87
Residential: 1/3 acre (30% IC)	57	72	81	86
Residential: 1/2 acre (25% IC)	54	70	80	85
Residential: 1 acre (20% IC)	51	68	79	84
Residential: 2 acre (12% IC)	46	65	77	82
Open Space: Poor Condition	68	79	86	89
Open Space: Fair Condition	49	69	79	84
Open Space: Good Condition	39	61	74	80
Undeveloped Areas				
Pasture, grass land or range: Poor Condition	68	79	86	89
Pasture, grass land or range: Fair Condition	49	69	79	84
Pasture, grass land or range: Good Condition	39	61	74	80
Meadow – continuous grass	30	58	71	78
Brush: Poor Condition	48	67	77	83
Brush: Fair Condition	35	56	70	77
Brush: Good Condition	30	48	65	73
Woods-grass combination: Poor Condition	57	73	82	86
Woods-grass combination: Fair Condition	43	65	76	82
Woods-grass combination: Good Condition	32	58	72	79
Woods: Poor Condition	45	66	77	83
Woods: Fair Condition	36	60	73	79
Woods: Good Condition	30	55	70	77
"Poor" consists of less than 50 percent coverage. "Fair" consists of between 50 and 75 percent coverage. "Good" consists of greater than 75 percent coverage.				

Curve numbers can be reduced by either using a climatic adjustment as described in the 2016 TxDOT Hydraulic Design Manual (HDM) [4] or calibrating to historical storms. If curve numbers are calibrated from historical storms, the Engineer must provide documented data for rainfall, stream flow data, or detention pond stage storage data used to determine the historical curve numbers.

3.4.2 LAG TIME

Time of concentration shall be computed using the same techniques as for the Rational Method. The lag time, defined as the time between the center of mass of excess rainfall to the runoff peak, is typically used in the Hydrologic Modeling System (HEC-HMS) implementation of the NRCS methodology. The lag time can be estimated with Equation 3-7.

$$T_l = 0.6T_c \qquad \text{(Equation 3-7)}$$

The NRCS Unit Hydrograph shall be analyzed using 24-hour rainfall depths provided in Table 3-2. The 24-hour rainfall depths are to be distributed temporally with the NRCS Type III rainfall distribution.

CHAPTER 4 DESIGN OF DRAINAGE INFRASTRUCTURE

4.1 General Requirements

The following sections apply to the design of improvements within existing or proposed public ROW to minimize the interference to traffic and the likelihood of stormwater damage to surrounding property.

4.2 Street Flow

Interference to traffic is regulated by design limits of the spread of water into traffic lanes. Runoff shall not enter private property from a street except in recorded drainage easements or ROW, or in historic watercourses where easements or ROW have not been obtained.

Driveways should be constructed to allow the runoff from a 25-year design storm to pass under the driveway in a culvert (18 inches minimum or equivalent) or over the driveway on a concrete apron where conveyance is parallel to the roadway. Concrete aprons or box culverts are preferred in areas of heavy sediment transport.

The side slope of a ditch or swale on the side adjacent to City roads shall be no steeper than 4H:1V. Roadways under TxDOT jurisdiction shall be designed in accordance with TxDOT requirements.

4.2.1 Flow at Intersections

As the stormwater flow approaches a street or tee intersection, an inlet is required. The inlet cannot be placed inside the curb return. Valley gutters can be useful in diminishing the deterioration of pavements, particularly at intersections where flows tend to concentrate. At the intersection of two (2) thoroughfare or arterial streets, a valley gutter cannot be used. At the intersection of two (2) collector streets or local streets, the valley gutter may be used. At an intersection of two (2) different types of streets, a valley gutter may be used across the smaller street only.

4.2.2 Permissible Spread of Water

The flow of water in gutters of typical streets during the 25-year storm shall be contained below the top of curb and shall maintain the clear width requirements listed in Table 4-1. The flow of water shall be limited to a maximum of 6-inches above the top of crown during the 100-year storm event and must be contained within the defined ROW and easements. These clear widths at the crown of the roadway or at the high point on a divided roadway are necessary to provide access for vehicles in the event of an emergency.

Table 4-1: Water Spread Limits for Roadways

Street Classification	25-year permissible water spread
Thoroughfare	All lanes must remain open
Arterial Street	One 11-foot traffic lane must remain open in each direction
Collector Streets	Clear width of 11-feet must remain open
Minor Streets	Maximum depth of 6-inches

4.2.3 Street Flow Calculations

Evaluation of street flow is based upon open channel hydraulics theory, with the Manning's Equation modified to allow direct solution, based on the street cross section. The methodology included in the *Hydraulic Engineering Circular 22: Urban Drainage Design Manual (HEC 22)* [5] should be followed for determining proposed roadway improvements.

4.3 Inlet Design

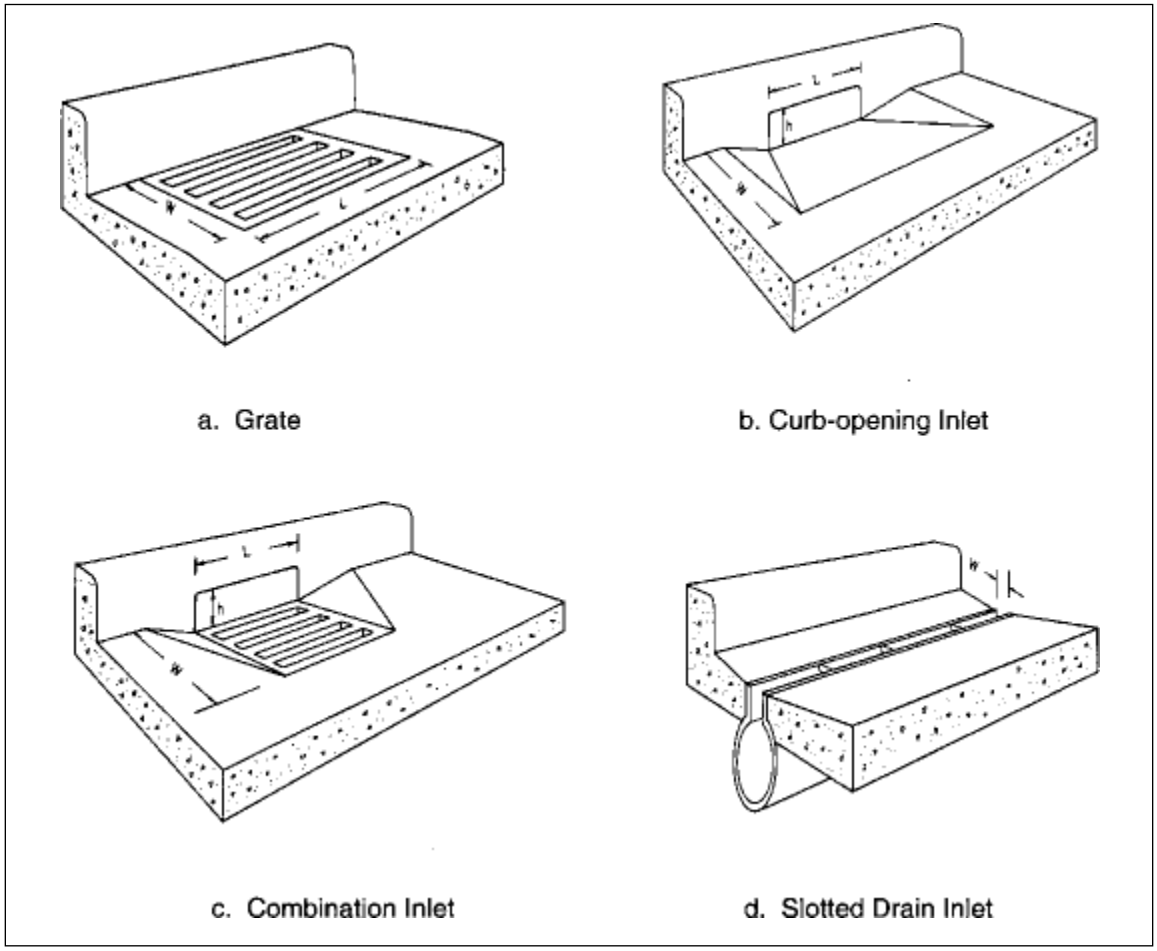
Inlets shall be located as necessary to remove the flow based on the 25-year storm and accommodate ponding widths in streets as defined in Table 4-1. The hydraulic efficiency of storm drain inlets varies with the amount of gutter flow, street grade, street crown, and the geometry of the inlet opening. No lowering of the standard height of street crown shall be allowed for the purposes of obtaining additional hydraulic capacity.

4.3.1 Inlet Types and Descriptions

Storm drain inlets are designed to collect and convey runoff to a storm drainage system. They are typically located at the street curb, paved medians, and in roadside and median ditches. The inlets are commonly divided into four categories:

a. Grate inlets
b. Curb-opening inlets
c. Combination inlets
d. Slotted drain inlets

Figure 4-1: Types of Storm Drainage Inlets



Source: HEC 22

4.3.1.1 Grate Inlets

Grate inlets are installed in the area of the roadway where the water is flowing and perform reasonably over a wide range of gutter grades. Some of the disadvantages are they lose capacity with increase in grade, may clog by debris, and pose a hazard to bicycle and wheelchair traffic. Therefore, these inlets must be configured to be safe for wheelchairs and bicycles.

4.3.1.2 Curb-Opening Inlets

Curb-opening inlets function effectively on flatter slopes or sags and where there is potential for a significant amount of debris in the gutter flow. They lose interception capacity as the gutter grade increases and therefore are recommended to be placed in grades no steeper than 3%.

4.3.1.3 Combination Inlets

Combination inlets have a high runoff interception capacity as they incorporate both the grate inlet and the curb opening inlet. If the curb opening is placed upstream of the grate inlet, it will act as a "sweeper" by intercepting floating debris in the early phase of a storm.

4.3.1.4 Slotted Drain Inlets

Linear inlets, slotted drains and trench drains, are placed in areas where runoff needs be intercepted over a wide section with low flows. The main disadvantage is they are very vulnerable to clogging from sediments and debris. Slotted drains may only be used with City permission. Trench drains are acceptable for use on driveways and low volume areas.

4.3.2 Inlet Capacity Calculations

The inlet capacity calculations shall be performed using the methodology contained in the TxDOT HDM.

4.3.2.1 Inlets On-Grade

The interception capacity of inlets on grade is dependent on the cross slope, longitudinal slope, total gutter flow, and pavement. The interception capacity of all inlet configurations increases with increasing flow rates, and inlet efficiency generally decreases with increasing flow rates. Designs must account for bypass flow.

4.3.2.2 Inlets in Sag Configurations

Inlets in a sag locations operate as weirs under low head conditions and as orifices at greater depths. Orifice flow begins at depths dependent on the grate size, the curb opening height, or the slot width of the inlet. At depths between those at which weir flow prevails and those at which orifice flow prevails, flow is in a transition stage. At these depths, control is ill defined and flow may fluctuate between weir and orifice control.

The efficiency of inlets in passing debris is critical in sag locations because all runoff which enters the sag must be passed through the inlet. Total or partial clogging of inlets in these locations can result in hazardous ponded conditions. Grate inlets alone are not recommended for use in sag locations because of the tendencies of grates to become clogged. Combination inlets or curb opening inlets are recommended for use in these locations.

4.4 Storm Drain Systems

The combined street system, including ditches, swales, and channels, directs flow into a collection structure, such as an inlet or grate, and deposits flow into the storm drain system. The objective is to provide safe passage of vehicle traffic by collecting stormwater from roadway surfaces and safely conveying it to an adequate receiving body.

4.4.1 General Requirements

The following shall be considered during the design of storm drain systems.

a. Storm drain pipe shall be reinforced concrete pipe (AASHTO M170 Class III). Corrugated metal pipe or plastic pipe shall not be permitted for storm drain systems in the public ROW.
b. Manholes or junction boxes must be used at all pipe size changes on trunk lines. For all pipe junctions, other than manholes and junction boxes, manufactured wye connections should be used, and the angle of intersection shall not be greater than 45 degrees. Laterals shall be connected to trunk lines using manholes or manufactured wye connections. Vertical curves in the conduit will not be permitted, and horizontal curves must meet manufacturer's requirements for offsetting of the joints.
c. The maximum manhole and junction box spacing for storm drain systems are shown in Table 4-2. Manholes or junction boxes shall also be placed at pick up points having three or more laterals; vertical alignment changes; and future collection points. The requirement for manholes may be waived if the pipe size allows direct access into the pipe by maintenance personnel and equipment.
d. The cover over the crown of circular pipe should be at least three feet and should be based on the type of pipe used, the expected loads, and the supporting strength of the pipe. Box sections should normally have a minimum of one foot of cover; however, box sections may be designed for direct traffic in special situations with approval.
e. Grates for drop inlets should be designed to facilitate removal for maintenance, but minimize vandalism. Design shall consider traffic loading, bicycle and pedestrian safety, and a means to secure the grate.
f. At no time shall bypass flow exceed the water spread limits for roadways as defined by Table 4-1. Inlets shall be located to prevent water convergence and/or excessive flows through intersections.
g. For arterial or collector streets with super-elevated sections, no more than 3 cubic feet per second of the 25-year flow will be allowed to cross from the higher elevation to the lower elevation.

Table 4-2: Maximum Manhole Spacing

Pipe Diameter (in)	Max. Spacing (ft)
24	400
27-39	800
42-60	1,000
Larger than 60	1,200

4.4.2 Design Criteria

The capacity of a storm drain network has several limiting factors, including the total incoming flow dependent on the severity of the storm, size, shape, and material of the network pipes, flow rate, and velocity, geometric changes causing energy losses, and exiting structure. To design a storm drain system, the following criteria will be used to create a system with the necessary capacity.

a. The design storm shall be the 25-year storm with provisions made for the 100-year storm. Design of storm drain systems shall follow the TxDOT HDM, utilizing Manning's Equation for closed conduits and step backwater methodology for open channels. For Manning's equation, the minimum roughness coefficient for a concrete storm pipe is 0.013.
b. Conduits within the storm drain system shall have a minimum velocity of 2 feet per second. This requirement shall protect the ability of the system to convey the design storm by limiting or preventing the accumulation of sediment within closed conduits.

c. Maximum conduit velocities for trunk lines and inlet laterals longer than 30 feet are 12 feet per second. A maximum velocity is required to prevent the erosion of the storm pipe material over time. The exiting velocity of a given storm drain system must be below the design velocity for the receiving channel or outfall structure. Erosion control measures are required for all outfalls into natural channels.
d. All energy losses, including entrance and exit losses, expansion losses, manhole and bend losses, junction losses, and minor head losses at points of turbulence, shall be included in calculations to determine the hydraulic gradient.
e. Storm lines discharging into open channels shall have flowlines higher or equal to those of the receiving open channel. The storm system is not allowed to be at sump with the channel.
f. Slope, along with larger diameter pipes located downstream, must be utilized such that the velocity of flow features a gradual increase, or at a minimum prevent large decreases at changes in geometry, including bends and inlets, to prevent sedimentation from occurring.
g. At connections of pipes with differing diameters, the pipe crowns (soffits) shall be matched, instead of matching the flow lines.

4.4.3 Calculation of the Hydraulic Grade Line

The hydraulic grade line (HGL) for a conduit system must be calculated with the inclusion of all energy losses and depicted in the system profile drawing. The hydraulic grade line must be computed and drawn for both the 25-year design storm and the 100-year storm. The methodology for calculating the hydraulic grade line is located in HEC 22.

4.4.3.1 Tailwater Conditions

The capacity of a system is dependent on the tailwater conditions, thus the tailwater conditions must be determined prior to designing storm drain systems. When calculating the hydraulic performance of a storm drain system discharging into an existing watercourse, tailwater elevation must be determined by the design engineer. However, the tailwater elevation must be greater than the existing water surface of the receiving channel and the minimum outlet water surface.

The design engineer must also determine the maximum outlet velocities of the storm drain network and include the “Normal Depth” outfall analysis. As a part of the analysis, the design engineer must solve the downstream boundary condition using Manning’s equation for Normal Depth.

4.4.3.2 Head Loss

To design a conduit system, the head loss within the system must be computed. The head loss is the combined friction losses, minor losses, and junction losses for the system. The procedure for calculating head loss is included in the TxDOT HDM.

4.5 Open Channels

The general classifications for open channels are natural channels, which include all watercourses that have been carved by nature through erosion; and engineered channels, which are constructed or existing channels that have been significantly altered by human effort. No person shall place or cause to be placed any obstruction of any kind in any watercourse within the City and its ETJ. The owner of any property within the City, through which any watercourse may pass, shall keep the watercourse free from obstruction.

4.5.1 Design Criteria

The parameters that need to be considered in channel design include: flow capacity, permissible velocity, side slope, and freeboard.

- Flow Capacity: All channels shall be designed to convey the 100-year storm event with freeboard in accordance with Table 2-4;
- Permissible Velocity: The minimum permissible velocity is 2 fps for the 25-year storm. The maximum permissible velocity for the 100-year storm must be non-erosive; and
- Side Slopes: The channel slopes shall be 3H:1V or flatter.

4.5.2 Roughness Coefficients

The roughness coefficients describe the degree of resistance that natural or artificial channels have to flow conveyance. The recommended roughness coefficient values for use in open channel hydraulic analyses are presented in Table 4-3.

Table 4-3: Roughness Coefficients

Type of Channel and Description	Minimum	Normal	Maximum
LINED OR BUILT-UP CHANNELS			
Concrete-lined	0.012		0.025
Concrete rubble	0.017		0.030
UNLINED CHANNELS			
Earth, straight, and uniform	0.017		0.025
Winding and sluggish	0.022		0.030
Rocky beds, weeds on bank	0.025		0.040
Earth bottom, rubble sides	0.028		0.035
Rock cuts	0.025		0.045
NATURAL STREAMS			
Minor Streams (top width at flood stage<100 ft)			
Streams on plain			
clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
clean and straight with more stones and weeds	0.030	0.035	0.040
clean, winding, some pools and shoals	0.033	0.040	0.045
clean and winding but some weeds and stones	0.035	0.045	0.050
same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
clean, winding, some pools and shoals with more stones	0.045	0.050	0.060
sluggish reaches, weedy, deep pools	0.050	0.070	0.080
very weedy reaches or floodways with heavy underbrush	0.075	0.100	0.150
Floodplains			
Pasture, no brush			
short grass	0.025	0.030	0.035
high grass	0.030	0.035	0.050
Brush			
scattered brush, heavy weeds	0.035	0.050	0.070
light brush and trees, in winter	0.035	0.050	0.060
light brush and trees, in summer	0.040	0.060	0.080
medium to dense brush, in winter	0.045	0.070	0.110
medium to dense brush, in summer	0.070	0.100	0.160
Trees			
dense willows, summer, straight	0.110	0.150	0.200
cleared land with tree stumps, no sprouts	0.030	0.040	0.050
cleared land with tree stumps with heavy growth of sprouts	0.050	0.060	0.080

Type of Channel and Description	Minimum	Normal	Maximum
heavy stand of timber and little undergrowth	0.080	0.100	0.120
same as above with flood stage reaching branches	0.100	0.120	0.160
Major Streams (top width at flood stage>100 ft)			
Regular section with no boulders or brush	0.025		0.060
Irregular and rough section	0.035		0.100

4.5.3 CHANNEL ANALYSIS

For the analysis and design of open channels the depth and velocity of flow are necessary. For the hydraulic analysis of open channels, the following two methods are commonly used:

- Slope Conveyance Method
- Standard Step Backwater Method

The above two methods of analysis are included in the TxDOT Hydraulic Design Manual.

4.5.4 SUPERCRITICAL FLOW

The Froude Number, Equation 4-1, provides a relationship between flow velocity and the hydraulic depth of flow, and gravitational action and shall be calculated for all channel improvement designs. Subcritical flow conditions occur when the Froude Number is less than 1.0 and supercritical flow conditions exist in lined channels when the Froude Number exceeds 1.0.

If the normal depth in a channel is supercritical, its alternate depth is a deeper subcritical depth. Obstructions that may enter a stream during a storm event may cause supercritical flows to experience a hydraulic jump and become subcritical flows. When it is calculated that supercritical conditions could occur for the design storm, the depth of the channel must be at least the alternate depth plus the required freeboard. Adequate protection of the channel must be provided to protect against supercritical flow.

Subcritical flow conditions are recommended for all channel designs, as supercritical flow tends to have high velocities and high potential for channel erosion. Supercritical flow conditions will not be allowed in channels with a vegetative lining. Subcritical flow conditions may be achieved by using energy dissipators in areas where the existing topography will not allow subcritical flow conditions to occur naturally. In all cases, the channel improvements shall be designed to avoid the unstable transitional flow conditions that occur when the Froude Number is between 0.9 and 1.1.

$$F = \frac{v}{\sqrt{gD}}$$ Equation 4-1

Where:

F=Froude number (dimensionless)
v=average velocity (ft/s)
g=gravitational acceleration (32.3 ft/s^2) D=hydraulic depth (ft)

4.5.5 SHEAR STRESS

Shear stress represents the component of stress that acts in the direction of the flow. Shear stress shall be computed for all open channels and adequate protection shall be provided based on the tractive force method described in HEC 15 [6] and the permissible shear stresses reported in the TxDOT HDM.

The shear stress at normal depth should be computed. The channel lining selected, Table 4-4, will determine the permissible shear stress, Table 4-5. If the computed shear stress is less than the permissible

stress, the lining is adequate. Otherwise, consider the following options: choose a more resistant lining, decrease channel slope, decrease slope in combination with drop structures, or increase channel width or flatten side slopes. Non-native plants are prohibited for use within channels.

Table 4-4: Retardation Class for Lining Materials

Retardance Class	Cover	Condition
A	Weeping lovegrass	Excellent stand, tall (average 30 in. or 760 mm)
B	Native grass mixture little bluestem, bluestem, blue gamma, other short and long stem midwest grasses	Good stand, uncut
	Weeping lovegrass	Good Stand, tall (average 24 in. or 610 mm)
	Lespedeza sericea	Good stand, not woody, tall (average 19 in. or 480 mm)
	Alfalfa	Good stand, uncut (average 11 in or 280 mm)
	Weeping lovegrass	Good stand, uncut (average 13 in. or 330 mm)
	Blue gamma	Good stand, uncut (average 13 in. or 330 mm)
C	Crabgrass	Fair stand, uncut (10-to-48 in. or 55-to-1220 mm)
	Bermuda grass	Good stand, mowed (average 6 in. or 150 mm)
	Common lespedeza	Good stand, uncut (average 11 in. or 280 mm)
	Grass-legume mixture: summer (orchard grass redtop, Italian ryegrass, and common lespedeza)	Good stand, uncut (6-8 in. or 150-200 mm)
	Centipedegrass	Very dense cover (average 6 in. or 150 mm)
	Kentucky bluegrass	Good stand, headed (6-12 in. or 150-305 mm)
D	Bermuda grass	Good stand, cut to 2.5 in. or 65 mm
	Common lespedeza	Excellent stand, uncut (average 4.5 in. or 115 mm)
	Buffalo grass	Good stand, uncut (3-6 in. or 75-150 mm)
	Grass-legume mixture: fall, spring (orchard grass Italian ryegrass, and common lespedeza	Good Stand, uncut (4-5 in. or 100-125 mm)
	Lespedeza sericea	After cutting to 2 in. or 50 mm (very good before cutting)
E	Bermuda grass	Good stand, cut to 1.5 in. or 40 mm
	Bermuda grass	Burned stubble
Source: TxDOT HDM		

Table 4-5: Permissible Shear Stress for various linings

Protective Cover	(lb/sf)
Retardance Class A Vegetation	3.70
Retardance Class B Vegetation	2.10
Retardance Class C Vegetation	1.00
Retardance Class D Vegetation	0.60
Retardance Class E Vegetation	0.35
Woven Paper	0.15
Jute Net	0.45
Single Fiberglass	0.60
Double Fiberglass	0.85
Straw W/Net	1.45
Curled Wood Mat	1.55
Synthetic Mat	2.00
Gravel, D50 = 1 in. or 25 mm	0.40
Gravel, D50 = 2 in. or 50 mm	0.80
Rock, D50 = 6 in. or 150 mm	2.50
Rock, D50 = 12 in. or 300 mm	5.00
6-in. or 50-mm Gabions	35.00
4-in. or 100-mm Geoweb	10.00
Soil Cement (8% cement)	>45
Dycel w/out Grass	>7
Petraflex w/out Grass	>32
Armorflex w/out Grass	12-20
Erikamat w/3-in or 75-mm Asphalt	13-16
Erikamat w/1-in. or 25 mm Asphalt	<5
Armorflex Class 30 with longitudinal and lateral	>34
Dycel 100, longitudinal cables, cells filled with mortar	<12
Concrete construction blocks, granular filter	>20
Wedge-shaped blocks with drainage slot	>25
Source: TxDOT HDM	

4.5.6 ENERGY DISSIPATORS

Energy dissipators are commonly used for culverts and channels in order to prevent erosion problems by dissipating the flow energy at specific locations prior to discharging downstream. Design methodology for these structures is presented in HEC-14 [7].

The energy dissipators fall under different categories including:

- Internal Dissipators
- Stilling Basins
- Streambed Level Dissipators
- Riprap Basins and Aprons
- Drop Structures
- Stilling Wells

4.6 Bridges and Culverts

A bridge is defined as a structure, including supports, erected over a depression or having a roadway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between faces of abutments, spring lines of arches, or extreme ends of openings for multiple box culverts. Culverts convey surface water through a roadway embankment away from the roadway ROW or into a channel along the ROW.

4.6.1 General Requirements

All proposed bridges and culverts must meet the following criteria:

a. All culverts shall be a minimum size of a 18-inch circular pipe or equivalent for alternate shapes. Reinforced concrete shall be the material of choice. Other materials must be approved by the City.
b. Allowance shall be made for conveyance of the 100-year runoff across the road and into the downstream channel without damage to the road or adjacent property.
c. Temporary crossings shall be designed to safely pass the 2-year design storm runoff.
d. The backwater created by a culvert or bridge during the 100-year design storm runoff shall not cause damage to public or private property.
e. Culvert outlets shall be designed to minimize damage caused by erosion.
f. Culverts and bridges shall be aligned with natural drainage ways in grade and direction whenever practical. Culverts shall have a minimum design storm velocity of 2.5 feet per second to reduce sediment accumulation.
g. Larger culvert sizes, bridges, box culverts, and/or smooth-walled pipes are recommended for crossings where heavy debris or sediment accumulations are anticipated. Trash racks may be required.
h. All headwalls shall be constructed of reinforced concrete.

4.6.2 Bridge Design Criteria

Additional design criteria from that stated above will be on a case-by case basis as determined by the City Engineer.

4.6.3 Culvert Design Criteria

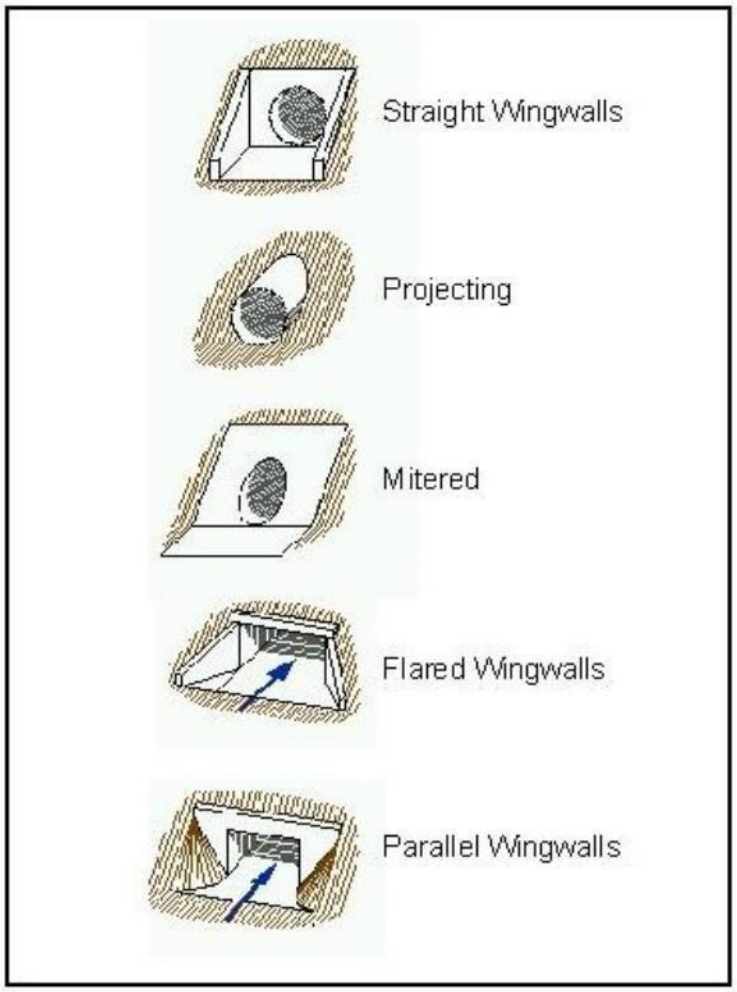
All proposed culverts shall be designed to meet the following criteria:

a. Headwalls and necessary erosion protection shall be provided at all culverts and shall comply with TxDOT standard details. All culverts and bridges are to be analyzed at both the design flow and 100-year check flow.
b. Alignment, location, and grade of proposed culverts must be consistent with planned development of the drainage system for that watershed. In the event the particular watershed or waterway is not covered by a planned storm drainage system, the designer should proceed with the design from the nearest downstream control and design the proposed drainage system improvements anticipating future system expansion due to fully developed watershed conditions.
c. Wingwalls, if used, may be either straight parallel, flared, or tapered. Approach and discharge aprons shall be provided for all culvert headwall designs. Precast headwalls and end walls may be used if all other criteria are satisfied.

4.6.4 CULVERT END TREATMENTS

End Treatment of a culvert is to create safer conditions surrounding the culvert without interfering with the hydraulics of the culvert design. There are a multitude of end treatments available for culverts. The TxDOT Bridge Division maintains standard details of culvert end treatments. Typical end treatments are depicted in Figure 4-2. Safety end treatments (SET), such as those used with driveway and other small diameter culverts, may be more hydraulically efficient by providing both tapered wingwalls and a beveled edge instead of using a mitered section. For larger culverts that are not protected by a railing or guard fence, pipe runners arranged either horizontally or vertically shall be used on all SET installations.

Figure 4-2: Typical Culvert End Treatments



Source: TxDOT HDM [4]

The pipe of pipe runner SETs have been proven to be within the tolerance of the entrance loss equation. Therefore, the entrance should be evaluated solely for its shape and the effect of the pipes on the entrance loss equation should be ignored.

4.6.5 CULVERT HYDRAULICS

The hydraulic design of culverts shall be based upon design guidelines set forth by TxDOT, the U.S. Department of Transportation, or other suitable material as approved by the City. Computer programs such as FHWA's "HY-8" may be used, provided that the design engineer provides output tables showing models results and input data.

Values of entrance loss coefficients (Ce) are shown in Table 4-6 based on culvert shape and entrance condition.

Table 4-6: Entrance Loss Coefficients

Entrance Configuration	Ce
CONCRETE PIPE	
Projecting from fill, socket end (groove end)	0.2
Projecting from fill, square cut end	0.5
Headwall or headwall and wingwalls:	-
Socket end of pipe (groove end)	0.2
Square-edge	0.5
Rounded (radius 1/12 D)	0.2
Mitered to conform to fill slope	0.7
End section conforming to fill slope	0.5
Beveled edges, 33.7º or 45º bevels	0.2
Side- or slope-tapered inlet	0.2
CORRUGATED METAL PIPE OR PIPE ARCH	-
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square-edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
End section conforming to fill slope	0.5
Beveled edges, 33.7º or 45º bevels	0.2
Side- or slope-tapered inlet	0.2
REINFORCED CONCRETE BOX	-
Headwall parallel to embankment (no wingwalls):	-
Square-edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension, or beveled edges on 3 sides	0.2
Wingwalls at 30º to 75º to barrel:	-
Square-edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension, or beveled top edge	0.2
Wingwall at 10º to 25º to barrel: square-edged at crown	0.5
Wingwalls parallel (extension of sides): square-edged at crown	0.7
Side- or slope-tapered inlet	0.2
Source: TxDOT HDM [4]	

There are two categories of flow through culverts: inlet control and outlet control.

a. Inlet Control: The flow is controlled by the cross-sectional area of the culvert, inlet configuration, and headwater depth. Slope, roughness, and length of culvert are of no importance. Nomographs are available for inlet control estimations as proved in Hydraulic Design of Highway Culverts [8].
b. Outlet control: The flow is controlled by the cross-section area of the culvert, inlet configuration, and headwater depth and, slope, roughness and length of culvert. Culverts will be outlet controlled if the culvert slope is relatively flat, the tailwater sufficiently deep, or the culvert is quite long. It is also possible, where the water enters the culvert under inlet control, but the culvert slope, or tailwater conditions cause a hydraulic jump near the outlet. This situation should be avoided because damage can occur to the culvert pipe. Unstable conditions are most likely when the culvert is placed at a near-critical slope.

The design engineer shall calculate both outlet and inlet control conditions and use the more conservative of the two as the design condition.

4.6.6 Culvert Outlet Protection

High discharge velocities from culverts can cause eddies or other turbulence, which could damage unprotected downstream channel banks and roadway embankments. To prevent damage from scour and erosion in these conditions, culvert outlet protection is needed. The outlet protection should extend downstream to a point where non-erosive channel velocities or shear stress are established in accordance with Section 4.5.5 of this manual. The outlet protection should be placed sufficiently high on the adjacent banks to extend 1 foot above the design water surface elevation. All outlet protection shall be designed with an appropriate toe depth. All toes shall be no less than twenty-four inches.

4.6.7 Energy Dissipation

Design of riprap stone protection shall be done in accordance to *HEC 22*. Design of concrete baffles and stilling basins shall be done in accordance with *HEC 14*.

CHAPTER 5 DETENTION FACILITIES

Detention is the storage of runoff for a controlled release during or immediately following a design storm. The detention facility shall be appropriate to the type of development, topography, and amount of control needed.

5.1 General Requirements

All proposed detention facilities must achieve the following requirements:

a. The method(s) of detention shall be appropriate to the type of development, topography, and amount of control needed. Examples of methods include, but are not limited to, the following:
    a. Basins or swales – single or multiple
    b. Check dams in gullies to slow runoff and trap sediment
    c. Contour terracing, improved vegetation cover
b. Parking areas may be used as detention facilities provided that maximum depths of ponding do not exceed eight inches and ponding is in the areas most remotely situated from structures.
c. Stormwater infiltration systems are not permitted for mitigation in any development where there is potential for pollutants to adversely affect ground water quality (e.g. Edwards Aquifer Recharge Zone).
d. No detention basin shall retain standing water for longer than 36 hours unless it is designed and constructed to be a permanent pond with appropriate health, safety and water quality measures. Permanent ponds must comply with all applicable water rights requirements for such a body of water.
e. Detention basins to be excavated shall provide positive drainage through the pond. Consideration should be given to pond slope and erosion protection.
f. Finished floors of adjacent structures should be a minimum of 1 foot above the 100-year water surface in the facility. Facilities should preferably be located such that the invert of the outlet structure is above the 100-year water surface level in the receiving body; but in all cases, facilities shall be designed to function properly during conditions where the outlet is submerged by the tailwater of the receiving stream.
g. Detention facilities shall be designed with one or more outlet structures to allow safe passage of the 100-year post-development design storm runoff. Emergency overflow weirs shall also be required. Overflow weirs shall consider where overflow is directed and where feasible, direct overflows to easements and ROW but shall in no case adversely impact adjacent properties or streams.
h. Weirs, spillways, and outlets shall be protected from erosion with riprap, grouted riprap, or other methods of erosion control to protect the structure and downstream channel. Outflows shall be conveyed within proposed property limits or easement to an appropriate receiving drainage facility in a manner such that roadways, private property, buildings, etc. are not damaged.
i. Best management practices shall be used in the event a detention facility empties into another storage facility downstream. The timing of the hydrograph from the detention facility shall be checked against the timing of the receiving storage facility to prevent any increase in the flow rate from the downstream facility.
j. Side slopes of earthen embankments shall be designed for stability and safety, with side slopes of earthen banks shall be 3H:1V or flatter. All constructed stormwater structures of earthen material shall be re-vegetated to mature growth.
k. Maximum water depths over 6 feet shall not be allowed without prior approval from the City. Any detention facility that is classified as a dam by the TCEQ shall conform to the more stringent of rules listed in this manual or the dam safety rules adopted by TCEQ.
l. Earthen embankments of a height greater than 3 feet used to impound a required detention volume must have a minimum top-width of 4 feet, shall contain a non-permeable core, and shall

be based on a geotechnical investigation for the site. Compaction of all earthen drainage structures shall be to 90% standard proctor.

m. A maintenance ramp shall be provided for access in detention basin design for periodic desilting and debris removal. Access shall be provided to all ponds and channel maintained by the City, regional drainage facilities, or any other drainage facility designed for drainage of more than one privately maintained single-family lot as follows: ponds and channels shall provide a maintenance access with a width of at least 12 feet and have a vertical grade no steeper than 6H:1V. Access shall be provided within dedicated ROW or within the drainage easement and shall be clearly identified on plans.

   Maintenance schedules and descriptions of maintenance practices for privately maintained single-family residential ponds and channels shall be provided within the plans or as a separate document. Adequate access shall be provided for the maintenance description provided.

n. Basins with permanent storage must include dewatering facilities to provide for maintenance.
o. The design of detention facilities shall include provisions for collecting and removing sediment deposited after collecting and releasing stormwater.
p. Detention ponds and reservoirs shall provide freeboard based on Table 2-4 of this manual for the 100-year storm event measured from top of berm to the 100-year water surface elevationof the pond.

5.2 Design Criteria

The purpose of a stormwater detention basin is to temporarily impound (detain) excess stormwater, thereby reducing peak discharge rates. Therefore, all detention ponds are to be designed to prevent an increase in flow to the existing5, 25, and 100-year peak runoff leaving a proposed site. The design engineer must use the NRCS unit hydrograph as outlined in Section 3.4 of this manual.

5.3 Outlet Structure Design

To reduce the5, 25, and 100-year post-developed design storm flows to pre-development levels, a multi-level outlet structure may be required. The required documentation for the design of any detention structures includes design hydrographs, calculations of stage-storage-discharge tables, drawings of the basin, spillway, weir and outlet size and location along with necessary erosion control measures. For further guidance for design and construction of outlet structures, the design engineer should reference the Stormwater Detention Outlet Control Structures [9].

5.3.1 ORIFICES

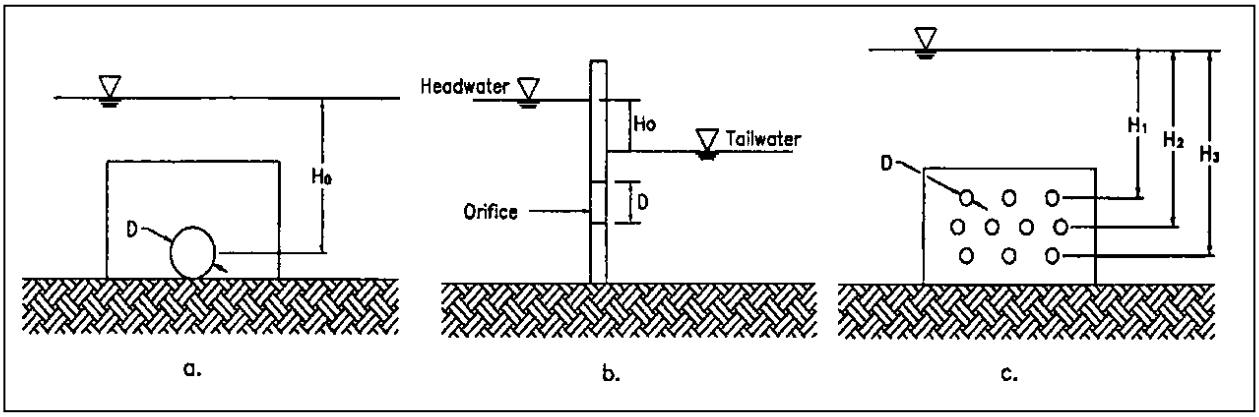
The orifice flow for a single orifice, depicted in Figure 5-1, can be calculated from Equation 5-1.

$$Q = C_0 A_0 (2gH_0)^{0.5} \qquad \text{(Equation 5-1)}$$

Where:

Q= Orifice flow rate (cfs)
C_0= Discharge coefficient 0.40-0.60
A_0= Area of orifice (sf)
H_0= Effective head on the orifice measured from the centroid of the opening (ft)
g = Gravitational acceleration = 32.2 ft/s^2

Figure 5-1: Definition Sketch for Orifice Flow



Source: HEC 22 [5]

For orifices discharging as a free outfall, the effective head is measured from the centerline of the orifice to the water surface elevation. For submerged orifices, the effective head is the difference in elevation between the upstream and downstream water surface elevations. A submerged orifice can be seen in Figure 5-1(b).

The discharge coefficient for orifices depend on the entrance conditions and shape of the orifice. For a square-edged orifice with uniform entrance conditions, the discharge coefficient should be 0.6. However, for ragged edged orifices, such as occurring when using an acetylene torch to cut the orifice opening into a corrugate pipe, 0.4 should be used for the discharge coefficient.

Design engineers may analyze pipes with a diameter of 1 foot or less as a submerged orifice as long as H_0/D is greater than 1.5. If the diameter of the pipe is greater than 1 foot, it must be analyzed as a discharge pipe and the design engineer must take into account both headwater and tailwater effects.

When dealing with flow through multiple orifices, as seen in Figure 5-1(c), the sum of the flow through each individual orifice is the total flow through them all. For multiple orifices of the same size and operating under the same effective head, the flow through one orifice can be multiplied by the number of openings to find the total flow.

5.3.2 WEIRS

Weirs are typically one of four types: sharp crested, broad-crested, V-notch, or proportional. The following section provides the required relationships for each type of weir. Design procedures are provided in HEC 22.

5.3.2.1 Sharp Crested Weirs

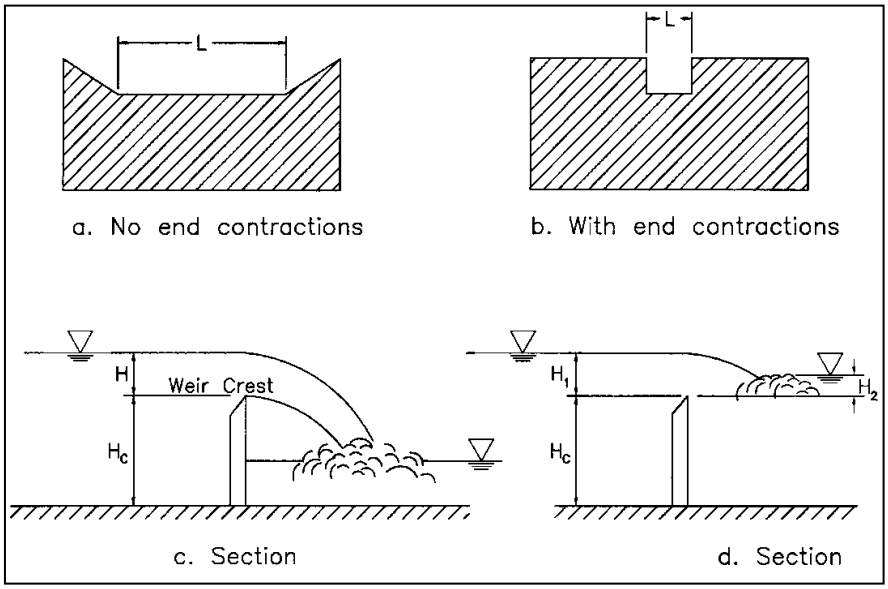
Typical sharp crested weirs are shown in Figure 5-2.

When a sharp crested weir has an end contraction, as shown in Figure 5-2(b), the equation changes, as follows:

$$Q = C_{SCW}(L - 0.2H)H^{1.5} \qquad \text{(Equation 5-4)}$$

The Sharp Crested Weir coefficient varies linearly with the ratio H/H_c and is typically set equal to 3.33 (English units) when the ratio of H/H_c is less than 0.3.

Figure 5-2: Sharp Crested Weirs



Source: HEC 22 [5]

5.3.2.2 Broad-Crested Weir

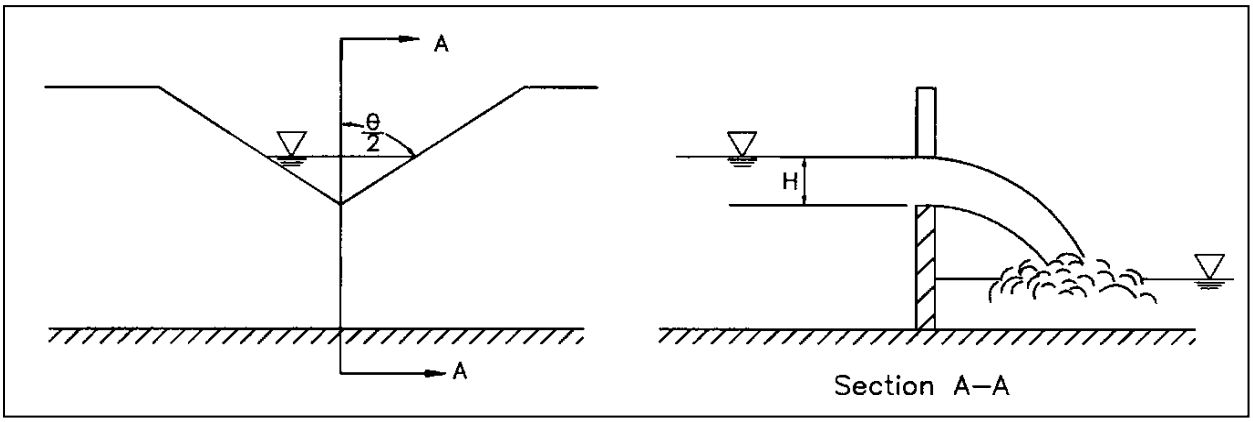
The broad crested weir coefficient is dependent on the breadth of crest of weir and head. Several commonly used broad crested weir coefficients are used for specific cases.

- If the upstream edge of a broad-crested weir is so rounded as to prevent contraction and if the slope of the crest is as great as the loss of head due to friction, flow will pass through critical depth at the weir crest; this gives the maximum C value of 3.09.
- For sharp corners on the broad crested weir, a minimum value of 2.62 should be used.

5.3.2.3 V- Notch Weir

Typical sections for a V-notch weir can be seen in Figure 5-3.

Figure 5-3: V-Notch Weir

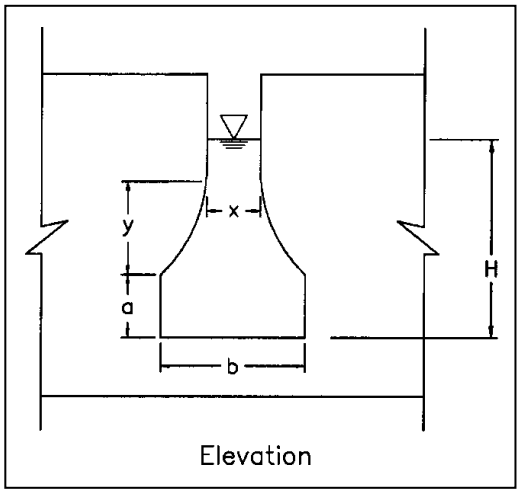


Source: *HEC 22* [5]

5.3.2.4 *Proportional Weir*

Although more complex to design and construct, a proportional weir has the potential to significantly reduce the required storage volume for a given site. Unlike the other three types of weirs, the proportional weir has a linear head-discharge relationship. The linear relationship evolves from allowing the discharge area to vary non-linearly with head. Dimensions for a proportional weir are shown in Figure 5-4.

Figure 5-4: Proportional Weir Dimensions



Source: *HEC 22* [5]

5.3.3 Discharge Pipes

Discharge pipes may be used as outlet structures for detention basins. An outlet structure utilizing discharge pipes can be designed one of two ways, either as a single or multistage discharge.

A single discharge system consists of a single discharge pipe or culvert. The single discharge system is designed as a simple culvert would be. As in Section 4.6.3 of this manual, the downstream boundary conditions would be applied in the same manner. The end computations would be a stage-discharge curve developed for the full range of flows that the single system may experience. The single pipe does not include a system to carry emergency flows.

A multistage discharge system does include a control structure at the inlet end of the pipe. This inlet control structure must be designed with the full range of flows under consideration. As with the single discharge system, a stage-discharge curve would be developed for all potential flows the system may experience. The design flows will typically be orifice flow through whatever shape the designer has chosen while the higher flows will typically be weir flow over the top of the control structure.

Orifices can be designed as outlined in Section 5.3.1 and weirs can be designed as shown in Section 5.3.2. The pipe must be designed to carry all flows considered in the design of the control structure.

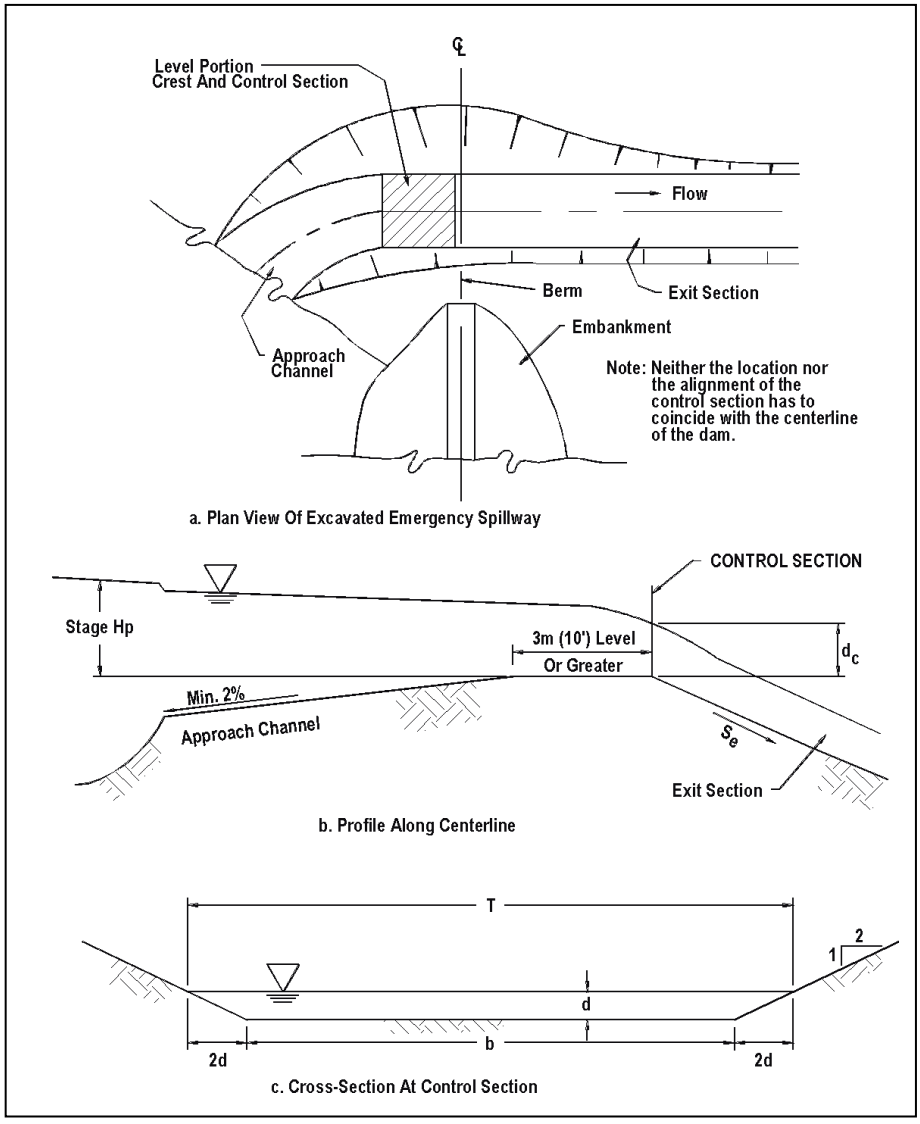
In designing a multistage structure, the designer would first develop peak discharges that must be passed through the facility. The second step would be to select a pipe that will pass the peak flow within the allowable headwater and develop a performance curve for the pipe. Thirdly, the designer would develop a stage-discharge curve for the inlet control structure, recognizing that the headwater for the discharge pipe will be the tailwater that needs to be considered in designing the inlet structure. Last, the designer would use the stage-discharge curve in the basin routing procedure.

5.3.4 Emergency Overflow Weirs

When storms occur, resulting in storm flows exceeding the design discharge of the detention basin, emergency overflow weirs allow a controlled relief of the excess water. Typically, an emergency overflow weir

has a trapezoidal cross-section design for its constructability. For small ponds with outfall structures comprising of pipe-systems, an emergency weir will need to be designed to carry the full 100-year storm, assuming all pipes are blocked. For larger ponds with outfall structures comprising of box culverts or graduated weirs, the emergency weir will be designed to carry the 500-year storm event. The typical emergency overflow weir is shown in Figure 5-5. Emergency overflow weirs that do not incorporate a spillway should be treated as a broad-crested weir.

Figure 5-5: Emergency Spillway Design Schematic



Source: *HEC 22* [5]

The discharge coefficient varies as a function of the bottom width of the spillway and the effective head on the spillway. Design parameters for the relationship are included in HEC 22.

The critical slopes are based upon an assumed Manning's coefficient of 0.040 for turf cover of the spillway. For a paved spillway the Manning's coefficient should be 0.015. The Manning's coefficient is dependent on the spillway material and must be adjusted according to the design developed by the design engineer.

CHAPTER 6 MITIGATION OPTIONS

Mitigation options other than detention would include constructing improvements, or other measures that mitigate or otherwise improve the water course's ability to handle increased runoff from the site without causing adverse impact to adjacent or downstream properties.

Examples could include:

- Low Impact Development (LID) Features
- Improving off-site drainage infrastructure
- Swales
- Channels
- Storm Drain installation or upsizing
- Culverts
- Clearing of underbrush
- Shared drainage easement between the adjacent owners with an agreement per state law.

It should be noted that some of these options may require drainage easements from adjacent property owners or at a minimum written permission from these property owners to access the property.

The options listed above are some potential opportunities of consideration. Alternatively, the user may evaluate opportunities to not provide detention and directly consider improving impacted infrastructure. Lastly, the user may provide detention and mitigate the increase in flow, so there is no longer an impact to the downstream infrastructure. Detention will be used as a last-resort mitigation option and only allowed with the City Engineer's approval. Detention requirements may be waived if 50% of newly proposed impervious cover is treated with LID features and no adverse impact can be demonstrated (request for waived detention must be proposed during the permitting process of newly proposed impervious cover).

If the user has a reasonable explanation for not providing detention, they may consider the following:

- If there is any storm drainage infrastructure such as storm-inlets, culverts, etc: Then the user may consider upsizing the culverts by including additional pipes or boxes; may consider upsizing the inlet capacity to a larger inlet size and further replace underground storm pipes to accommodate the excess flow.
- If the flow goes through other properties, the user may consider channeling it to keep the flow extents same as existing conditions. This can be done using engineering channels such as grass-lined or concrete lined (which need maintenance) or can be done using vegetated swales which need less maintenance.
- For minor increases in flow, the user may consider clearing existing underbrush on the downstream side, to be able to reduce the manning's roughness coefficients, which can achieve a reduction in water surface elevations.
- Also, for minor increases in flow, a LID feature may be included which could potentially help with mitigating both water quantity and quality.
- A shared drainage easement between the adjacent property owners, established and governed by a written agreement executed and recorded in accordance with applicable state law. The easement designates a defined area for the conveyance of flow and/or drainage improvements, and grants each owner the continuing right to use, access, and maintain the drainage facilities within that area. Both owners are obligated to preserve the intended drainage function, refrain from obstructing or altering the easement in a manner that interferes with water flow, and comply with all maintenance, repair, and cost-sharing responsibilities as outlined in the agreement.

6.1 Low Impact Development (LID) Features

Low Impact Development (LID) Features as an alternative to traditional detention can often be incorporated into landscaping to provide aesthetics without requiring additional disturbance or requiring off-site improvements. For further guidance, reference the latest published Travis County Low Impact Development standards.

Examples could include:

- Biofiltration ponds
- Rain gardens
- Rainwater harvesting
- Irrigation & Infiltration fields
- Sedimentation filtration ponds
- Vegetated filter strips
- Wet ponds
- Vegetated rooftops
- Permeable pavement
- Bioswales
- Planter Boxes

CHAPTER 7 ADVERSE IMPACT ANALYSIS

In many cases the proposed development will not cause an adverse impact on adjacent properties, or detention may cause increased impact.

Examples include:

- Discharge directly into a natural or manmade waterway with adequate capacity
- Increase onsite flow path length and incidental storage
- Point discharge from detention basins
- Timing of hydrographs

Methods to verify no adverse impact include: Mitigation through LID features, downstream drainage infrastructure improvements or detention. Engineer of Record to provide analysis and supporting data that verify No-Adverse Impact. A detailed hydrologic analysis is defined as a computer model based on rainfall-runoff methodology using software similar to HEC-HMS. A detailed hydraulic analysis is defined as a computer model that calculates water surface elevations using a step-backwater method; such as HEC-RAS. Two-Dimensional models that can dynamically integrate hydrology and hydraulics, such as XP-SWMM, ICM or HECRAS 2D, can also be used for detailed analysis submittal. The purpose of the detailed analysis is to demonstrate no increases to the 5-yr, 25-yr and 100-year water surface elevations at a point just downstream of the site and at a zone of influence point established based on the 10% drainage area rule.

7.1 10% Zone of Influence

Engineer to analyze the watershed to a point where the site represents 10% of the total watershed. For example, if a site is 2 acres. The engineer will study the flow path to a point where the watershed is a total of 20-acres or greater. The engineer must show through analysis and data that the proposed development of the 2 acres site will not cause an adverse impact within this 20-acre watershed. If there is an adverse impact, then mitigation will be required.

7.2 Natural Water Courses

Water courses with drainage areas in excess of 100 acres will require detailed hydrology and hydraulic analysis to determine the flood inundation area within the property. The flood inundation area must be dedicated as a public drainage easement to allow for future maintenance and preservation of the natural water course.

7.3 Drainage Easements

Sites located within a FEMA-Designated Floodplain

When a site is located within a FEMA-designated floodplain, a drainage easement is required to preserve the hydraulic conveyance of the floodplain and to prevent adverse impacts to upstream and downstream properties. The easement ensures that flood flows can pass through the site without obstruction and provides access for inspection, future maintenance and flood risk management.

The Engineer shall provide a detailed flood study report that includes analysis supporting the FEMA Effective Floodplain, as well as any Best Available Model (BAM) (e.g., updated HEC-RAS models, restudies, or locally adopted models). The analysis shall establish the 1% annual chance (100-year) floodplain limits and associated water surface elevations.

If discrepancies exist between the FEMA Effective Floodplain and the Best Available Model, the Engineer shall compare the extents and water surface elevations and adopt the more conservative (wider) floodplain limits. The drainage easement boundaries shall be designated based on these limits to ensure adequate flood conveyance capacity and regulatory compliance. The easement shall fully encompass the floodplain and any additional area necessary to accommodate freeboard, maintenance access, and future model updates.

Sites not adjacent to a FEMA-Designated Floodplain

For sites not adjacent to FEMA-designated floodplain but are within a regulated stream (shown in Appendix C), a drainage easement is required due to the potential for significant stormwater runoff, flood conveyance needs, and potential impacts to adjacent properties.

For drainage areas exceeding 200 acres the Engineer shall conduct a 100-year ultimate development flood study to define the limits of the 1% annual chance (100-year) inundation boundary. The analysis shall evaluate existing, proposed, and ultimate development conditions and downstream tailwater impacts.

Based on the results of the flood study, the Engineer shall delineate the limits of the potential 100-year ultimate conditions floodplain. The drainage easement shall be sized to fully contain the modeled flood extents and provide adequate capacity for safe conveyance of runoff, sediment transport, and debris passage. The easement also serves to protect flood conveyance and ensures long-term access for inspection and maintenance.

7.4 Street Discharge

When a site discharges directly into the existing streets which do not have existing stormwater infrastructure in place (regardless of drainage area) the property owner must dedicate a drainage easement at least 15’ wide across the frontage of the property to allow for the construction and maintenance of drainage facilities.

7.5 Point Discharge

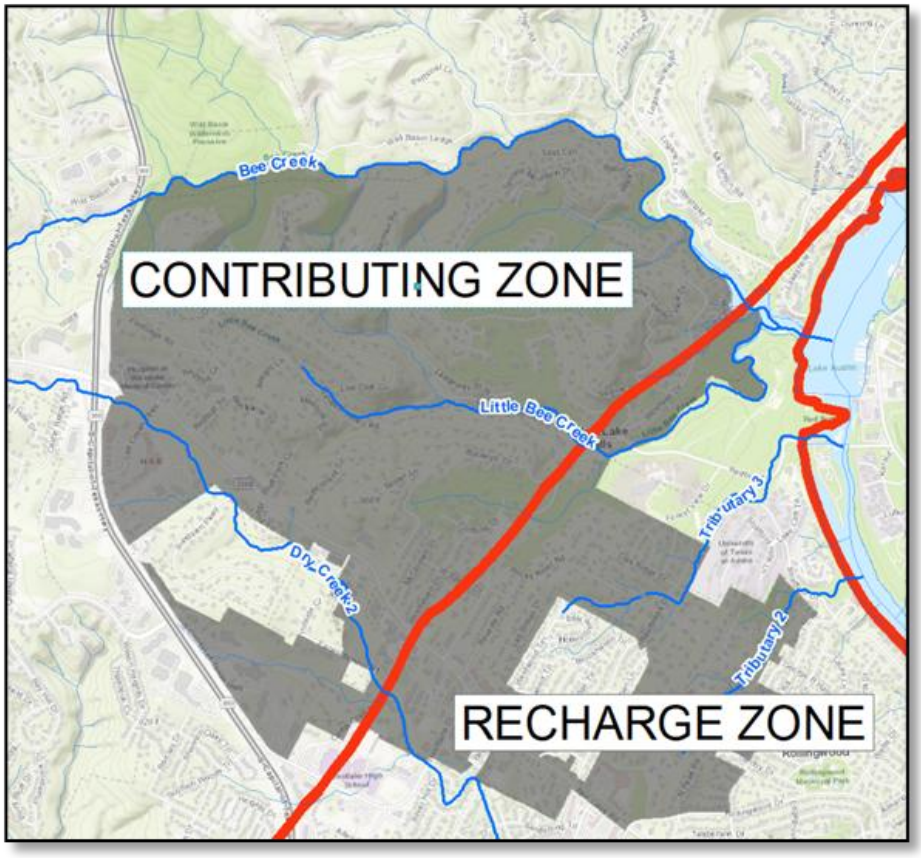
Concentration of runoff from a sheet flow condition into a point discharge will require an easement from the receiving property. This easement must be adequate to contain the received runoff during a 100-year design storm event. Alternatively, the point discharge must be returned to a sheet flow condition using a level spreader or other method sufficiently upstream of the property line to allow runoff to fully return to a sheet flow condition before reaching the property line.

CHAPTER 8 WATER QUALITY CONTROLS

Stormwater can have a significant impact on water quality in creeks and rivers within and downstream of the City. To maintain the integrity of the natural environment, the City requires controls to remove suspended particulate matter and associated constituents such as bacteria, nutrients, and metals from stormwater discharges.

8.1 Applicability

Permanent water quality controls for all developments within the City shall comply with the latest TCEQ published rules and technical design guidance. The selected Best Management Practice (BMP) or combination of BMPs must reduce the increase in total suspended solids (TSS) load associated with development by at least 80 percent. All single-family residential developments with impervious cover above 20% must provide water quality treatment for both the Recharge and Contributing Zones.



8.2 Design Criteria

Permanent water quality BMPs shall be designed to provide adequate treatment of impervious cover in the City's Jurisdiction. The selection and sizing of BMPs shall follow the procedures outlined in the latest version of the TCEQ Report Publication RG-348 [10], as amended. All BMPs included in the errata sheet and addendums are accepted for use.

8.3 Maintenance

The maintenance requirements for BMPs as defined by TCEQ must be followed for all BMPs and is the responsibility of the property owner. A copy of the recorded maintenance plan, as required by TCEQ, shall be provided to the City. Documentation of annual inspections required by the City or TCEQ shall be submitted to the City each year. Changes in the ownership and responsibility provided to TCEQ shall also be provided to the City of West Lake Hills.

8.4 Rainwater Harvesting System

For water quality determination, roof areas connected to a rainwater harvesting system do not count towards impervious cover for low density single-family residential developments. Applicants proposing a rainwater harvesting system at a minimum need to provide two impervious cover calculations, one to comply with building regulations and the other to comply with TCEQ.

If sized per the provided guidelines, developments can be exempt from the Edwards Aquifer protection plan application requirements by reducing the effective impervious cover below 20%. The volume of the rainwater collection system must be sufficient to retain the runoff from a 1.5-inch rainfall for all impervious cover above 20%. The rainwater harvesting container is to be sized for the entire roof area draining to the rainwater harvesting system if that area is larger than the area needed to bring the total impervious cover of the site below 20%. The system should be managed so that it is emptied at least weekly to provide storage for subsequent storms. This guidance is provided for reference only, applicants are advised to periodically check for updates to TCEQ guidelines, as TCEQ regulations take precedence. Within the drainage plan set, the rainwater harvesting system plan sheet should include a plan view identifying rooftop high points and gutter locations. The roof area contributing runoff to the storage tank must be clearly defined and delineated.

Formulas:

Required Water Quality (%) = ((Impervious Cover (ft^2) / Area of property (ft^2)) - 0.2) (100)

Minimum Rooftop Collection Area (ft^2) = Impervious Cover (ft^2) - (Area of property (ft^2) / 5)

*Minimum Tank Size (gallons) = ((Minimum Rooftop Collection Area (ft^2) x 144 in^2/ft^2) (1.5 in)) / 231 in^3/gal

*Actual Tank Size (gallons) = ((Actual Rooftop Collection Area (ft^2) x 144 in^2/ft^2) (1.5 in)) / 231 in^3/gal

*Round up to the nearest gallon

CHAPTER 9 EROSION CONTROL MEASURES

Private property owners, developers, or builders shall be accountable for erosion of their property or construction site which results in measurable accumulation of sedimentation in dedicated streets, alleys, waterways, or other properties. Sediment carried by stormwater runoff shall be prevented from entering storm drain systems and natural water courses.

9.1 General Requirements

a. Maximum use shall be made of vegetation to minimize soil loss. Vegetation measures should begin as soon as possible during construction in order to allow for establishment at construction termination.
b. Natural vegetation should be retained wherever possible, including trees. Where inadequate natural vegetation exists or where it becomes necessary to remove existing natural vegetation, temporary controls should be installed promptly to minimize soil loss and ensure that erosion and sedimentation does not occur.
c. During construction, erosion controls shall be used to slow drainage flow rate and prevent downstream sedimentation.
d. Erosion control elements should be implemented as soon as practical in the development process.
e. Waste or disposal areas and construction roads should be located and constructed in a manner that will minimize the amount of sediment entering streams.
f. Frequent fording of live streams will not be permitted; therefore, temporary bridges or other structures shall be used wherever an appreciable number of crossings of a stream are necessary.
g. When work areas or material sources are located in or adjacent to live streams, such areas shall be separated from the stream by a dike or other barrier to keep sediment from entering a flowing stream. Care shall be taken during the construction and removal of such barriers to minimize the sediment transport into a stream.
h. Should preventative measures fail to function effectively, the applicant shall act immediately to bring the erosion and/or siltation under control by whatever additional means are necessary.
i. Erosion control devices shall be placed to trap any losses from stockpiled topsoil. Some acceptable forms of site erosion control devices include, but are not limited to, silt fences, silt traps, and geotextiles. Hay bales are not permitted.
j. The selection and timing of the installation of erosion controls shall be based upon weather and seasonal conditions that could make certain controls not practicable.
k. Vegetation used for vegetative cover shall be suitable for local soil and weather conditions. Ground cover plants shall comply with listings from the Texas Agricultural Extension Service.
l. Stripping of vegetation from project sites shall be phased so as to expose the minimum amount of area to soil erosion for the shortest possible period of time. Phasing shall also consider the varying requirements of an erosion control plan at different stages of construction and shall include the establishment of new vegetation or permanent erosion control measures.
m. SWPPP shall follow TCEQ rules.

9.2 Edwards Aquifer

Development and redevelopment located over the Edwards Aquifer regulatory zones shall comply with the latest TCEQ published rules and technical design guidance for the Edwards Aquifer in accordance with 30 TAC Chapter 213 (Edwards Aquifer Rule) in addition to the provisions and requirements of TPDES General Permit Number TXR150000.

9.3 Temporary Erosion Control Measures (used during construction)

Erosion control and restoration measures shall be designed in conformance with the methods established by the TPDES General Permit Number TXR150000 regardless of disturbed acreage. TCEQ Report Publication RG-348 outlines the selection and design of temporary erosion control and sediment control measures.

9.3.1 Maintenance and Monitoring

Required temporary erosion control measures are to be installed prior to commencing construction and shall remain in place until vegetation is established and the construction area is stabilized. During the course of construction, the property owner is responsible for maintaining the integrity of all temporary erosion control measures. Maintenance requirements for the BMPs are included in TCEQ RG-348. In general, the site and vicinity shall be clear of debris and sediment. The property owner is responsible for cleaning and removing all sediment discharged from the site during the construction at the direction of the City.

9.3.2 Final Acceptance

All site related items must be complete in accordance with this Drainage and Erosion Control Design Manual prior to occupancy of the last building on a site. All subdivision-related drainage items must be completed prior to the recordation of the final plat. A Letter of Concurrence is required from the Engineer certifying completion of all stormwater detention and water quality management facilities prior to final acceptance.

9.4 Permanent Erosion Control Measures

Natural drainage patterns shall be preserved whenever possible. Drainage patterns should be designed to prevent erosion, maintain filtration and recharge of local seeps and springs, and attenuate the harm of contaminants collected and transported by storm water.

9.4.1 Cut/Fill Limits

In order to reduce stormwater runoff, resulting in erosion, sedimentation and conveyance of nonpoint source pollutants, the layout of the street network, lots and building sites shall, to the greatest extent possible, be sited and aligned along natural contour lines, and shall minimize the amount of cut and fill on slopes in order to minimize the amount of land area disturbed during construction. To determine average slope a total of up to five (5) continuous 1’ contours can be used in the analysis. The maximum cut and fill limits are shown in Table 9-1. Structures utilizing piers or cantilever structures over area left natural are not subject to cut / fill limits.

Table 9-1: Maximum Cut and Fill Limits

Slope	Open Cuts and Fills	Closed Cuts	Closed Fill
0 - 15%	3 feet	20 feet	6 feet
15 - 25%	1 foot	15 feet	6 feet
25% - 35%	0 feet	10 feet	6 feet
> 35%	0 feet	0 feet	0 feet

9.4.2 Stream Bank Erosion

Erosion control will be provided along streams and drainage channels. Where bank stabilization or other erosion protection measures are required to protect streams and channels, mitigation measures shall be detailed and calculations provided.

Appendix A: References

[1] W. Asquith, "Depth-Duration-Frequency of Precipitation for Texas," US Geological Survey Water Resources Investigations Report 98-4044, Austin, TX, 1998.

[2] "Urban Hydrology for Small Watersheds - Technical Release 55," Natural Resources Conservation Services, Washington, D.C., 1986.

[3] City of Austin, Drainage Criteria Manual, Austin, 2014.

[4] Texas Department of Transportation, "Hydraulic Design Manual," Austin, TX, 2016.

[5] US Department of Transportation, Federal Highway Administration, "Urban Drainage Design Manual, Hydraulic Engineering Circular No. 22," 3rd Edition, Washington, D.C, 2009.

[6] US Department of Transportation, Federal Highway Administration, "Design of Roadway Channels with Flexible Linings, Hydraulic Engineering Circular No. 15," 3rd Edition, Washington, D.C., 2005.

[7] US Department of Transportation, Federal Highway Administration, "Hydraulic Design of Energy Dissipaters for Culverts and Channels, Hydraulic Engineering Circular No. 14," 3rd Edition, Washington, D.C., 2006.

[8] US Department of Transportation, Federal Highway Administration, "Hydraulic Design of Highway Culverts, Hydraulic Design Series No 5," 3rd Edition, Washington, D.C., 2012.

[9] J. Jones, "Stormwater Detention Outlet Control Structures," *Great Works on Urban Water Resources,* Vols. 1962-2001, pp. 857-887, 2006.

[10] TCEQ, "Complying with Edwards Aquifer Rules Technical Guidance on Best Management Practices," Austin, Texas, July 2005.

Appendix B: Definition of Terms

100- year Event: Event (rainfall or flood) that statistically has a one percent chance of being equaled or exceeded in any given year.

Abutment: A wall supporting the end of a bridge or span, and sustaining the pressure of the abutting earth.

Apron: A floor or lining of concrete, timber, or other suitable material at the toe of a dam, entrance or discharge side of spillway, a chute, or other discharge structure, to protect the waterway from erosion from falling water or turbulent flow.

Backwater: The rise of the water level upstream due to an obstruction or constriction in the channel.

Baffles: Deflector vanes, guides, grids, gratings, or similar devices constructed or placed in flowing water to: (a) check or effect a more uniform distribution of velocities; (b) absorb energy; (c) divert, guide, or agitate the liquids; and (d) check eddy currents.

Calibration: Process of checking, adjusting, or standardizing operating characteristics of instruments and model appurtenances on a physical model or coefficients in a mathematical model. The process of evaluating the scale readings of an instrument in terms of the physical quantity to be measured.

Channel: Any path of concentrated flow that conveys storm runoff from a drainage area greater than 128 acres.

Channel stability: A condition in which a channel neither degrades to the degree that structures, utilities or private property are endangered, nor aggrades to the degree that flow capacity is significantly diminished as a result of one or more storm runoff events or moves laterally to the degree that adjacent property is endangered.

Closed cut: Excavations that prevent erosion by some permanent erosion control structure such as a reinforced concrete retaining wall, dry stacked stone, or other permanent erosion control device.

Closed fill: Embankments that prevent erosion by some permanent erosion control structure such as a reinforced concrete retaining wall, dry stacked stone, or other permanent erosion control device, including building foundations.

Conduit: Any open or closed device for conveying flowing water.

Critical Flow: The state of flow for a given discharge at which the specific energy is a minimum with response to the bottom of the conduit.

Crown: (a) The highest point on a transverse section of conduit; (b) the highest point of a roadway cross section.

Culvert: Large pipe or other conduit through which a stormwater flows under a road or street.

Curb Inlet: A vertical opening in a curb through which the gutter flow passes. The gutter may be undepressed or depressed in the area of the curb opening.

Degradation: The progressive general lowering of a stream channel by erosion.

Depression Storage: Collection and storage of rainfall in natural depressions (small puddles) after exceeding infiltration capacity of the soil.

Design Storm. The storm which is used as the basis for design, i.e., against which the structure is designed to provide a stated degree of protection or other specified result.

Detention: The storage of storm runoff for a controlled release during or immediately following the design storm.

a. **Off-site detention:** A detention pond located outside the boundary of the area it serves.

b. **On-site detention:** A detention pond which is located within and serves only a specific site or subdivision.

c. **On-stream detention:** Detention facilities provided to control excess runoff based on a watershed wide hydrologic analysis.

Developed land: Any lot or parcel of land occupied by any structure intended for human occupation, including structures intended for commercial or industrial enterprise.

Developer: Any individual, estate, trust, receiver, cooperative association, club, corporation, company, firm, partnership, joint venture, syndicate or other entity engaging in platting, subdivision, filling, grading, excavating, or construction of structures.

Disturbed area: Area impacted by construction including all vehicle access, material storage, building construction, pavement, and necessary workspace for construction

Downstream capacity: The ability of downstream drainage facilities to accept and safely convey runoff generated upstream.

Drainage basin: The storm water catchment area above a point on a channel to which waters drain and collect. Watershed has the same meaning.

Drainage easement: A platted area reserved for the primary purpose of stormwater drainage and maintenance.

Drainage System: Drainage systems shall include streets, alleys, storm drains, drainage channels, culverts, bridges, overflow swales, and any other facility through which or over which storm water flows.

Drop Inlet: A storm drain intake structure typically located in unpaved areas. The inlet may extend above the ground level with openings on one or more sides or it may be flush with the ground with a grated cover.

Entrance Head: The head required to cause flow into a conduit or other structure; it includes both entrance loss and velocity head.

Entrance Loss: Head lost in eddies or friction at the inlet to a conduit, headwall or structure.

Erosion control: Treatment measures for the prevention of damages due to soil movement and to deposition.

Excavation: Digging and removal of earth by mechanical means.

Fill: The placement of material such as soil or rock to replace existing material, or to create an elevated embankment. Fill also refers to the material which is placed.

Flood or Flooding: A general and temporary condition of inundation of normally dry land areas by surface runoff. The 100-year flood is the flow rate with a 1% probability of being equaled or exceeded in any one year.

Flood Hazard Area: Area subject to flooding by 100-year frequency floods.

Floodplain: Geographically the entire area subject to flooding. In usual practice, it is the area subject to flooding by the 100-year frequency flood. In this manual, the "100-year floodplain" refers to the floodplain resulting from a 100-year flood based on ultimate watershed development conditions. The "FEMA floodplain" shall refer to the area subject to flooding resulting from the 100-year flood for current watershed development conditions.

Freeboard: The distance between the normal operating level and the top of the side of an open conduit left to allow for wave action, floating debris, or any other condition or emergency without overtopping the structure.

Frequency: Average recurrence interval of a given storm event over long periods of time.

Froude Number: A flow parameter which is a measure of the extent to which gravitational action affects the flow. A Froude number greater than one indicates supercritical flow and a value less than one indicates subcritical flow.

Fully developed watershed: A hydrologic condition in which all areas upstream and downstream of a point in question are assumed completely developed, including any undeveloped areas, which are assumed to be developed in accordance with development densities established by the City

Gabion: A wire basket containing earth or stones, deposited with others to provide protection against erosion.

Grade: (a) The inclination or slope of a channel, canal, conduit, etc., or natural ground surface, usually expressed in terms of the percentage of number of units of vertical rise (or fall) per unit of horizontal distance. (b) The elevation of the bottom of a conduit, canal, culvert, sewer, etc. (c) The finished surface of a canal bed, road bed, top of an embankment, or bottom of excavation.

Grading: Any movement of soil, rock, or vegetation by artificial means, to include any or all of the following acts: clearing, grubbing, excavating, placement of fill material, or grading of land.

Grate Inlet: An opening in the gutter covered by one or more grates through which the water falls. As with all inlets, grated inlets may be either depressed or undepressed and may be located either on a continuous grade of in a sump.

Gutter: A generally shallow waterway adjacent to a curb, used or suitable for drainage of water.

Headwater: (a) The upper reaches of a stream near its sources; (b) the region where ground waters emerge to form a surface stream; (c) the water upstream from a structure.

Hydraulic Control: The hydraulic characteristic which determines the stage discharge relationship in a flowing stream or conduit. The control is usually critical depth, tailwater depth or uniform depth.

Hydraulic Grade Line: A line representing the pressure head available and elevation head at any given point within the system.

Impervious: A term applied to a material through which water cannot pass, or through which water passes with great difficulty.

Infiltration: (a) The entering of water through the interstices or pores of a soil or other porous medium; (b) the quantity of groundwater which leaks into a sanitary or combined sewer or drain through defective joints, breaks or porous walls; (c) The absorption of water by soil, either as it falls as precipitation or from a stream flowing over the surface.

Inlet: (a) An opening into a storm sewer system for the entrance of surface storm runoff, more completely described as a storm sewer inlet; (b) a structure at the diversion end of a conduit; (c) the upstream connection between the surface of the ground and a drain or sewer, for the admission of surface or storm water.

Interception: As applied to hydrology, refers to the process by which precipitation is caught and held by foliage, twigs, and branches of trees, shrubs and buildings, never reaching the surface of the ground, and then lost by evaporation.

Invert: The floor, bottom, or lowest portion of the internal cross-section of a conduit. Used particularly with reference to storm drains, sewers, tunnels, channels and swales.

Lag Time: In hydrograph analysis lag time is the time from the centroid of the mass of excess rainfall to the peak of the runoff hydrograph. See Time of Concentration.

Lining: The material placed on the sides and/or bottom of a ditch, a channel, and/or a reservoir to prevent or reduce seepage of water through the sides and bottom and/or to prevent erosion.

Maintenance: The cleaning, shaping, grading, repair, and minor replacement of drainage, flood control and erosion facilities, but not including the cost of power consumed in the normal operation of pump stations.

Manning's Coefficient: The coefficient of friction used in the Manning Equation to describe the surface roughness characteristics of a channel, floodplain, or sheet flow surface.

Manning's Equation: A uniform flow equation used to relate velocity, hydraulic radius and the energy gradient.

NRCS Runoff Curve Number: Index number used by the Soil Conservation Service as a measure of the tendency of rainfall to run off into streams rather than evaporate or infiltrate.

Open Channel: The general term for a conduit in which water flows with a free surface.

Open cut: Excavations that will not contain any form of permanent erosion control other than planting of ground cover.

Open fill. Embankments that will not contain any form of permanent erosion control other than planting of ground cover.

Orifice: (a) An opening with closed perimeter and regular form in a plate, wall, or partition, through which water may flow; (b) the end of a small tube, such as a Pitot tube, piezometer, etc.

Peak Flow: The maximum rate of runoff during a given runoff event.

Permeability: The property of a material which permits movement of water through it when saturated and actuated by hydrostatic pressure.

Pervious: Applied to a material through which water passes relatively freely.

Post development: The condition of the given site and drainage area after the anticipated development has taken place.

Precipitation: Any moisture that falls from the atmosphere, including snow, sleet, rain and hail.

Preliminary Drainage Plan: A schematic layout of the drainage system required for platting. The Preliminary Drainage Plan shall show locations of channels, storm sewers, detention structures, floodplain, floodway, and associated drainage easements at a minimum.

Pre-development: The condition of the given site and drainage area prior to development.

Rainfall Duration: The length of time over which a single rainfall event occurs.

Rainfall Intensity: The rate of rainfall, usually in inches or millimeters per hour.

Rational Formula: A traditional means of relating runoff from a drainage basin to the intensity of the storm rainfall, the size of the basin, and the characteristics of the basin (such as land use, impervious cover).

Reach: Any length of river or channel. Normally refers to sections which are uniform with respect to discharge, depth, area or slope, or sections between gagging stations.

Return Period: The average interval of time within which a given event is statistically predicted to be equaled or exceeded once.

Riprap (Revetment). Forms of bank channel protection, usually using rock or concrete. Riprap is a term sometimes applied to stone which is dumped rather than placed more carefully.

Right-of-way (ROW). A strip of land dedicated for public streets and/or related facilities, including utilities, drainage systems and other transportation uses.

Runoff: That part of the precipitation that exceeds the precipitation lost to evaporation, transpiration, interception, depression storage, and infiltration and reaches a stream or storm drain.

Runoff Coefficient: A decimal number used in the Rational Formula, which defines the runoff characteristics (i.e., land use impervious cover) of the drainage area under consideration. It may be applied to an entire drainage basin as a composite representation or it may be applied to a small individual area such as one residential lot.

Scour: The erosive action of running water, in streams or channels, in excavating and carrying away material from the bed and banks.

Sediment: Material of soil and rock origin transported, carried, or deposited by flowing water.

Sidewalk: A paved area within the street right-of-way specifically designed for pedestrians and/or bicyclists.

Soffit: The top of the inside of a pipe. In a pipe, the uppermost point on the inside of the structure.

Spillway: A waterway in or about a dam or other hydraulic structure for the escape of excess water.

Stilling Basin: Pool of water conventionally used, as part of a drop structure or other structure, to dissipate energy.

Subcritical Flow: Relatively deep, tranquil flow with low flow velocities. The Froude Number is less than 1.0 for subcritical flow conditions.

Supercritical Flow: Relatively shallow, turbulent flow with high velocities. The Froude Number is greater than 1.0 for supercritical flow conditions.

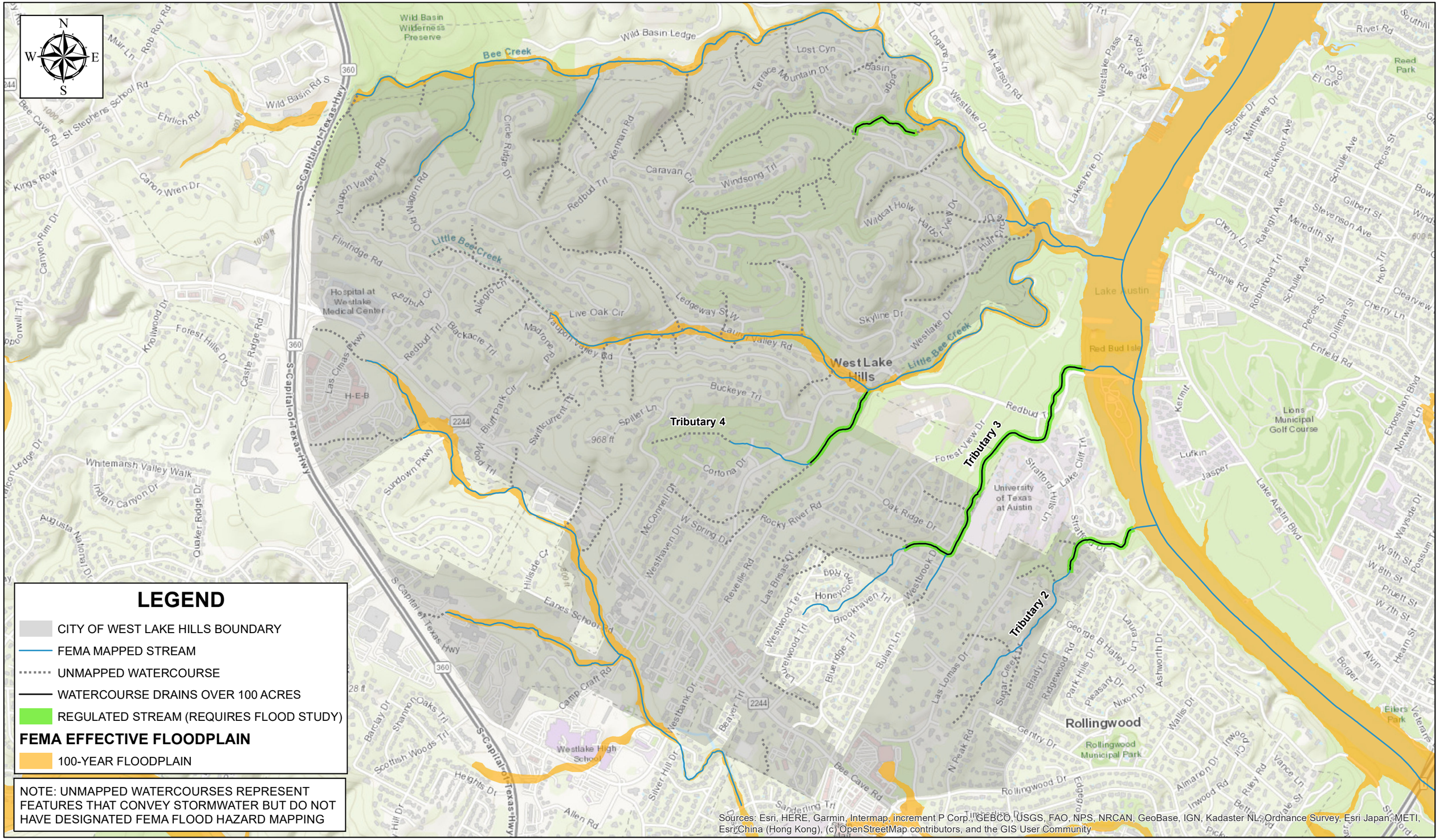
Tailwater: The depth of flow in the stream directly downstream of a drainage facility or other man made control structure.

Time of Concentration: The estimated time in minutes required for runoff to flow from the most hydraulically remote section of the drainage area to the point at which the flow is to be determined. Hydraulically remote refer to the travel path with the longest flow travel time, not necessarily the longest linear distance.

Ultimate Development: The condition of the watershed after the entire watershed has undergone development.

Unit Hydrograph: The direct runoff hydrograph resulting from one inch of precipitation excess, distributed uniformly over a watershed for a specified duration.

Watershed: The area contributing storm runoff to a stream or drainage system. Other terms are drainage area, drainage basin, and catchment area.



LEGEND

- CITY OF WEST LAKE HILLS BOUNDARY
- FEMA MAPPED STREAM
- UNMAPPED WATERCOURSE
- WATERCOURSE DRAINS OVER 100 ACRES
- REGULATED STREAM (REQUIRES FLOOD STUDY)

FEMA EFFECTIVE FLOODPLAIN

- 100-YEAR FLOODPLAIN

NOTE: UNMAPPED WATERCOURSES REPRESENT FEATURES THAT CONVEY STORMWATER BUT DO NOT HAVE DESIGNATED FEMA FLOOD HAZARD MAPPING

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

APPENDIX C: CITY OF WEST LAKE HILLS WATERCOURSE EXHIBIT

City *of* West Lake Hills
City Council

AGENDA REPORT

Meeting Date:	April 8, 2026	**Item Number:**	8
Department:	Administration		
Prepared By:	Trey Fletcher	**Cost / Budget:**	n/a
Exhibits:	None	**Source of Funds:**	n/a

Subject

Discuss code amendments related to Chapters 1, 20, 22, 32, 36 and 38 of the City Code.

Recommendation

Discuss and provide direction as appropriate.

Discussion

Staff will provide an update regarding the status of proposed code amendments emanating from architectural review committee recommendations and reallocation of duties associated with the City Council, Board of Adjustment, and the Zoning and Planning Commission.

Recommendation by ZAPCO is anticipated on April 15, and approval by City Council on April 22.

Proposed amendments consider changes within the following Chapters of the City Code:
- 1 (General Provisions),
- 20 (Administration)
- 22 (Building Regulations)
- 32 (Signs)
- 36 (Subdivisions) and
- 38 (Zoning)