ATTACHMENT J

PAE

# Cupertino City Hall: MEP Systems Alternatives Study

October 7, 2014

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## Contents

## Project Directory

**Owner**

**City of Cupertino**
10300 Torre Avenue
Cupertino, CA 95014
408-777-3200

**Architect**

**Project Architect**
2 Bryant Street, Suite 300
San Francisco, CA 94105
415-856-3000

**Karen Alschuler**
*Principal-in-Charge*
Karen.Alschuler@perkinswill.com

**Geeti Silwal, LEED AP BD+C**
*Associate Principal, Senior Project Manager*
Geeti.Silwal@perkinswill.com

**Mechanical & Electrical Engineer**

**PAE Consulting Engineers, Inc.**
425 California Street, Suite 1200
San Francisco, CA 94104
415-544-7500

**Mike Lucas, PE, LEED AP**
*Principal-in-Charge*
michael.lucas@pae-engineers.com

**Marco Alves, PE, LEED AP**
*Project Manager*
marco.alves@pae-engineers.com

**Harj Sidhu, PE, LEED AP**
*Electrical*
harjot.sidhu@pae-engineers.com

**Stuart Gregson, PE, LEED AP**
*Mechanical*
stuart.gregson@pae-engineers.com

## 1.0 Project Description

This report is a follow up to the "Cupertino City Hall Essential Services Facility Analysis" report produced on 3/27/2012 by Perkins + Will, AKH Structural Engineers, and PAE. Refer to the 2012 report for details information on existing systems.

At this time the design team is considering 5 options for the city hall building:

1. Option A – Upgrade city hall with life safety
2. Option B – Upgrade city hall with life safety + EOC
3. Option C – Gut and remodel city hall
4. Option D – New city hall building with basement parking
5. Option E – New city hall building with basement parking + council chambers

The following sections outline the Mechanical, Electrical, and Plumbing implications of each of the above options. TBD Consultants has been engaged to provide cost estimates of each of these options.

## 2.0 OPTION A - UPGRADE CITY HALL WITH LIFE SAFETY

### 2.1 Electrical

Existing Electrical equipment including Main Switchboard, panelboards, etc. are all well past their useful life. Replace all Electrical distribution equipment.

Existing wiring to be removed and new wiring to be pulled through new conduit.

Upgrade Fire Alarm to meet the latest Life Safety requirements.

Provide new lighting fixtures to meet the latest T24 requirements. Emergency power for egress fixtures, via local battery packs.

### 2.2 Mechanical

Demo existing 70-ton, 1986 vintage water cooled chiller in lower level mechanical room.

Demo existing 70-ton, closed circuit, 1986 vintage rooftop cooling tower.

Demo 1965 vintage gas fired non-condensing boiler in lower level mechanical room.

Demo lower level 1986 vintage VAV+ reheat air handling unit.

Add new 70 ton air-cooled chiller at roof/attic level.

Add (2) 400,000 Btu (input capacity) condensing boilers at basement level.

Add new pipe and pumps for chilled and hot water systems.

Add (2) new AHUs to basement level (15,000 cfm each).

Clean and reuse existing ductwork as much as possible.

Increase ventilation rate to today's standards, re-route ventilation air intake.

Demolish existing pneumatic VAV boxes.

Provide new VAV boxes with direct digital controls.

Provide new BMS with DDC controls for all equipment and terminal units with front end for basic control and monitoring functions.

### 2.3 Plumbing

Miscellaneous upgrades for ADA compliance per September 2014 ADA report, including repositioning toilet heights and correcting lavatory/drinking fountain access.

### 2.4 Fire Protection

Modify sprinklers for code updates.

### 2.5 Indirect Costs

Cost of building/locating the EOC elsewhere on campus. Council Chambers remains at the Community Hall. The operations of the facility is not included in the costing.

## 3.0 OPTION B - UPGRADE CITY HALL WITH LIFE SAFETY + EOC

### 3.1 Electrical

Existing Electrical equipment including Main Switchboard, panelboards, transformers etc. are all well past their useful life. Replace all Electrical distribution equipment.

Existing wiring to be removed and new wiring to be pulled through new conduit.

Existing Generator is well past it’s useful life. Replace with new generator.

Evaluate Generator capacity versus the latest EOC requirements. Minimum generator size to be 125kW to match existing size.

Upgrade Fire Alarm to meet the latest Life Safety requirements.

Provide new lighting and lighting controls to meet the latest T24 requirements. Emergency power for egress fixtures, via local battery packs.

### 3.2 Mechanical

Same points as Option A, also including the following:

Upgrade all duct, pipe, and equipment anchorage and seismic attachments to building structure. Replace duct and pipe connections with flexible joints throughout. All large equipment shall be spring isolated.

AHU to be placed in attic level or roof. Preliminary selection indicates (2) AHU's at 7'W x 28'L x 5'H (10,000 lbs each).

Boiler to be placed at roof level.

Add HVAC heating to generator load (AHU, Boiler, Pumps, will be on emergency power, connected to the generator).

### 3.3 Plumbing

Miscellaneous upgrades for ADA compliance per September 2014 ADA report, including repositioning toilet heights and correcting lavatory/drinking fountain access.

Upgrade all plumbing equipment and pipe anchorage and seismic attachments to building structure.

### 3.4 Fire Protection

Modify sprinklers for code updates.

Upgrade fire sprinkler pipe anchorage and seismic attachments.

### 3.5 Indirect Costs

Cost of operating the Council Chambers at the Community Hall is separate.

### 3.6 Floodplain Considerations

We understand that FEMA stipulations require that emergency equipment shall not be located within Special Flood Hazard Areas Zones A, AE, and AO (which are areas within the 100 year floodplain). The attached FEMA map shows flood plain areas in the City of Cupertino and near the project location indicating that the project location is not within the 100 year floodplain zones.

FEMA's 2007 Design Guide for Improving Critical Facility Safety from Flooding and High Winds, publication 543 (located here: http://www.fema.gov/media-library-data/20130726-1557-20490-1542/fema543_complete.pdf) advises that emergency equipment should be located above the 500 year flood elevation. While this is a design guideline and not necessarily a FEMA requirement, PAE recommends that the project design should attempt to comply with this guideline. Consideration should be given to relocating the emergency generator to a level above grade to mitigate the risk of flooding due to storm conditions or piping malfunctions within the building.

The attached map indicates that the project is within the 500 year floodplain; however it does not designate the specific elevation of the 500 year flood. PAE recommends that a qualified firm/organization should be engaged to consult on specific floodplain elevations and recommendations for FEMA compliant locations for the emergency generator.

## 4.0 OPTION C - GUT AND REMODEL CITY HALL

### 4.1 Electrical

Existing Electrical equipment including Main Switchboard, panelboards, transformers etc. are all well past their useful life. Replace all Electrical distribution equipment.

Provide new Electrical Distribution throughout the building. This includes new Main Switchboards, panelboards, and transformers.

Provide new conduits to distribute power.

New wiring

Existing Generator is well past it's useful life. Replace with new generator.

Evaluate Generator capacity versus the latest EOC requirements. Minimum generator size to be 125kW to match existing size.

Upgrade Fire Alarm to meet the latest Life Safety requirements.

Provide new lighting and lighting controls to meet the latest T24 requirements. Emergency power for egress fixtures, via local battery packs.

### 4.2 Mechanical

Same points as Option B, also including the following:

New thermal zoning layout.

New distribution ductwork.

New distribution piping.

Design for mixed mode natural + mechanical ventilation, possibly engaging light wells or light court for transfer air.

All new mechanical system is likely to remain an air based VAV + reheat system.

### 4.3 Plumbing

Provide new high efficiency, condensing gas water heater.

Provide all new piping for the following systems:

a) Domestic Cold and Hot water piping

b) Vent piping

c) Gas piping

d) Storm piping

e) Waste piping

Provide new (water conserving) plumbing fixtures, ADA compliant.

### 4.4 Fire Protection

New sprinkler system.

### 4.5 Indirect Costs

Cost of operating the Council Chambers at the Community Hall is separate.

### 4.6 Floodplain Considerations

Same as Option B.

## 5.0 OPTION D - NEW CITY HALL BUILDING + BASEMENT PARKING

### 5.1 Electrical

New incoming service

New distribution

New Lighting

New Generator

New Fire Alarm

### 5.2 Mechanical

New central hydronic equipment: geothermal slinky field (60,000 sf area) below basement parking, served by water to water heat pump. Although the basement parking footprint area is planned to be 45,000 sf a 60,000 sf excavation area may be available due to shoring requirements. If needed the slinky field can extend further into (below) the site, or can be located in another location that may already be planned for excavation for other campus reasons. If desired, the slinky field can be piped so as to accommodate potential future expansion should the slinky field ever be desired for use as a campus system serving multiple buildings.

- Take advantage of federal tax savings for geothermal systems: 10% Tax Credit year 1, and 100% depreciation over 5 years.

- City of Cupertino to determine tax liability and eligibility for tax savings programs. One option may be a Thermal Purchase Agreement (TPA) in which a tax-liable 3rd party procures the geothermal system and secures the tax savings, and the City of Cupertino purchases the thermal energy from the 3rd party.

New indoor services, including radiant heating/cooling with dedicated outdoor air system.

Garage ventilation with CO sensor control.

### 5.3 Plumbing

New incoming/outgoing services for Fire, Gas, Domestic Cold Water, Storm Drain, and Waste.

New high efficiency condensing gas water heater and associated components (recirculating pump, storage tank, expansion tank, etc.)

New water conserving plumbing fixtures, ADA compliant.

New plumbing piping systems.

### 5.4 Fire Protection

New sprinkler system.

### 5.5 Indirect Costs

Cost of operating the Council Chambers at the Community Hall is separate.

### 5.6 Floodplain Considerations

Same as Option B.

## 6.0 OPTION E - NEW CITY HALL BUILDING + BASEMENT PARKING + COUNCIL CHAMBERS

### 6.1 Electrical

Same as Option D

### 6.2 Mechanical

Same as Option D, with higher ventilation rates and equipment capacities and geothermal slinky field (70,000 sf area to account for additional area of council chambers).

### 6.3 Plumbing

Same as Option D

### 6.4 Fire Protection

Same as Option D

### 6.5 Indirect Costs

Assume EOC included.

### 6.6 Floodplain Considerations

Same as Option B.

## 7.0 ENERGY BENCHMARKING

Based on 2013 utility bills, the existing facility operates inefficiently at an energy cost rate of $3.65/sf-year and an Energy Use Intensity (EUI) of 92 kBTU/sf-year (based on a September 2014 study provided by the City). A modern, energy efficient new construction office building in this climate would operate at approximately $1.20/sf-year and 35 kBtu/sf-year.

Based on PAE's project experience, Figures 1 and 2 on the next page illustrate potential reductions in energy use and energy cost associated with each of the options described in this report.

Figures 3 and 4 illustrate preliminary life cycle cost analysis and total cost of ownership for the mechanical systems described in Options A-E. In this case, the first cost of Options D and E was normalized on an area basis for equal comparison to Option A, B, and C. The Option D and E costs shown here are as if these options had the same project area as Option A, B, and C.

Figures 3 and 4 show that even though Options C, D, and E have higher first costs, the total cost of ownership over time is significantly less compared to Options A and B. The simple paybacks on Options D and E are less than 10 years, and the 30 year total cost of ownership for Options D and E are millions of dollars less than any other option. This is something to consider for the life of a project that is expected to last 30 years or more.

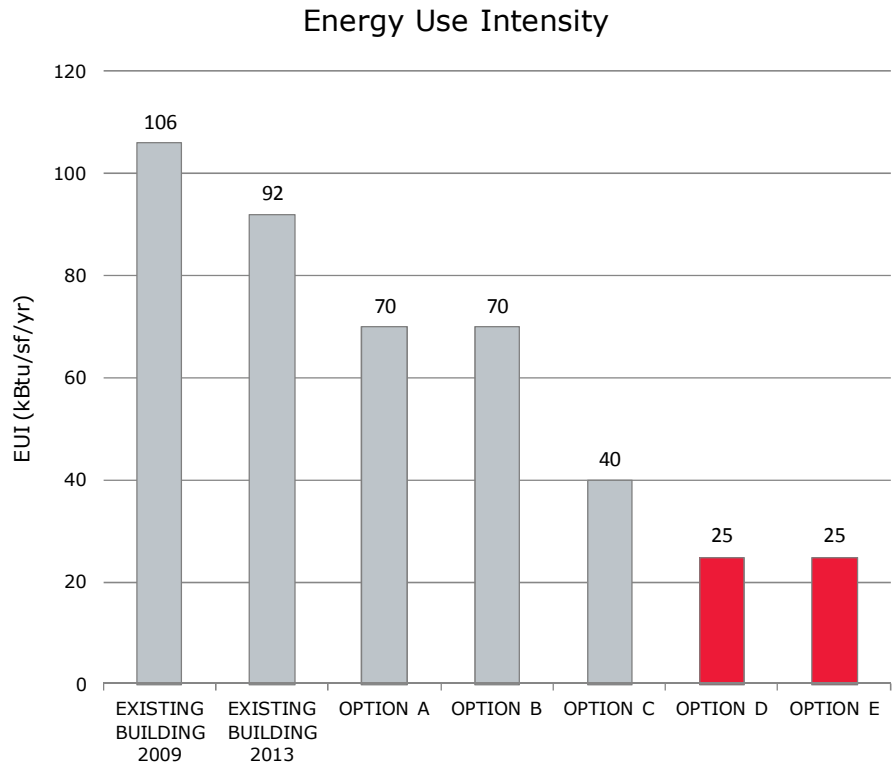



*Figure 1. Energy Use Intensity (EUI) comparisons*

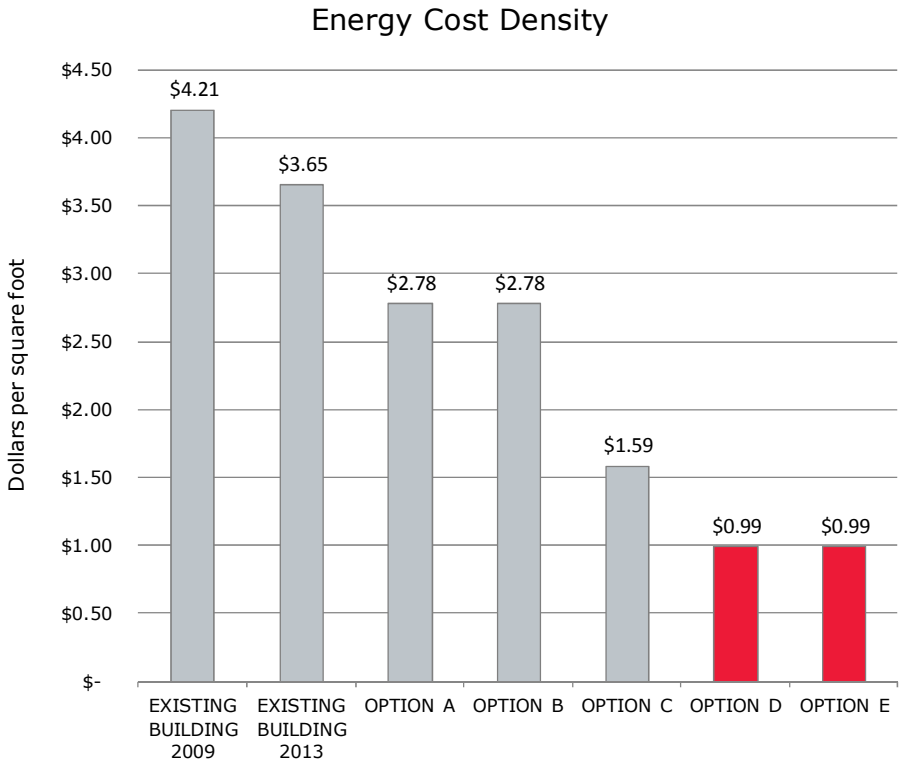



*Figure 2. Energy Cost Density comparisons*

LIFECYCLE COST ANALYSIS

BASED ON 30 YEAR ANALYSIS - 2014 to 2043

| Options | OPTIONS | Capital Costs ($)2014 | Avg. Annual Maint. Costs ($) | Avg. Annual Repla. Costs ($) | Year 1 Utility Costs ($)2014 | Simple Payback Option A Base (Years) | 15 Year Cost of Ownership ($)2028 | 30 Year Cost of Ownership ($)2043 | Energy Use Index (kBtu/sf-yr) |
|---|---|---|---|---|---|---|---|---|---|
| A | Option A -UPGRADE CITY HALL WITH LIFE SAFETY | $2,725,421 | $79,292 | $40,003 | $63,940 | - | $5,268,795 | $10,309,194 | 70 |
| B | Option B - UPGRADE CITY HALL WITH LIFE SAFETY + EOC | $3,065,022 | $79,292 | $40,003 | $63,940 | N/A | $5,608,396 | $10,648,795 | 70 |
| C | Option C - 4.0 OPTION C - GUT AND REMODEL CITY HALL | $3,710,142 | $47,575 | $40,003 | $36,570 | 16.7 | $5,290,933 | $8,523,976 | 40 |
| D | Option D - 5.0 OPTION D - NEW CITY HALL BUILDING + BASEMENT PARKING | $3,750,927 | $23,788 | $26,884 | $22,770 | 9.3 | $4,754,949 | $6,651,191 | 25 |
| E | Option E - 6.0 OPTION E - NEW CITY HALL BUILDING + BASEMENT PARKING + COUNCIL CHAMBERS | $3,705,176 | $23,788 | $26,884 | $22,770 | 8.9 | $4,709,199 | $6,605,441 | 25 |

Notes / Assumptions:

1. Capital Costs are based on reports from TBD consultants, dated 10/5/14 and 10/6/14, plus PAE estimates of controls costs. Capital costs of Options D and E are normalized by project area to create an even comparison with Options A, B, C. These are the costs if a new building was built with the same area as the existing building.

*Figure 3. Life Cycle Cost Analysis Results*

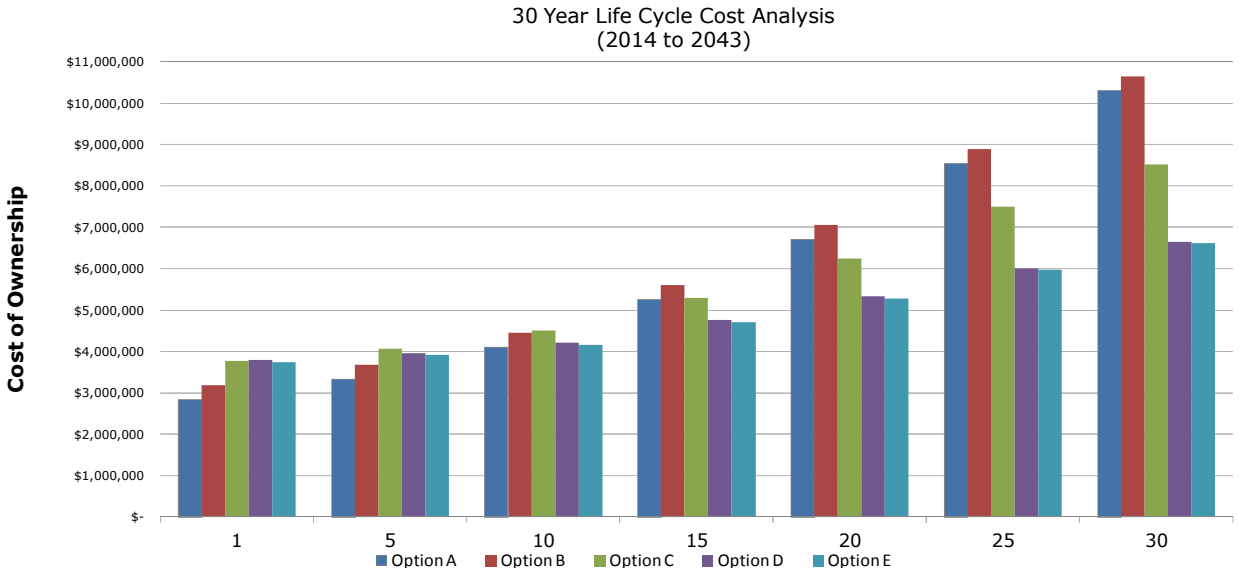



*Figure 4. Total Cost of Ownership over 30 years*

## NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

**Coastal Base Flood Elevations** shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 10. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zone used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

**Base map** information shown on this FIRM was provided in digital format by the USDA National Agriculture Imagery Program (NAIP). This information was photogrammetrically compiled at a scale of 1:24,000 from aerial photography dated 2005.

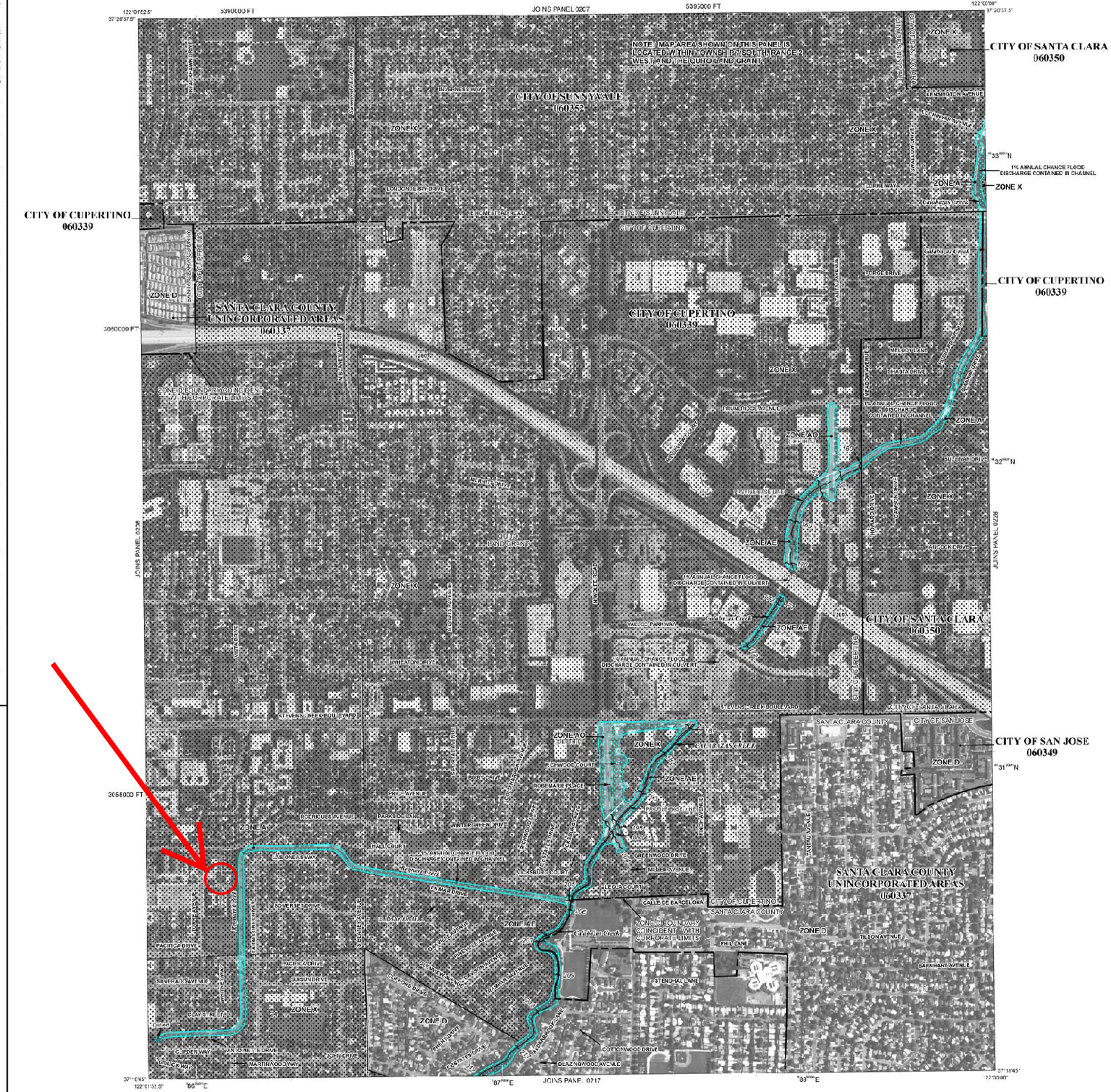
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.




## LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

| | |
|---|---|
| ZONE A | No Base Flood Elevations determined. |
| ZONE AE | Base Flood Elevations determined. |
| ZONE AH | Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined. |
| ZONE AO | Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined. |
| ZONE AR | Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood. |
| ZONE A99 | Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined. |
| ZONE V | Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined. |
| ZONE VE | Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined. |

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- B — B — Transect line
- 97°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 4276000 N — 1000-meter Universal Transverse Mercator grid values, zone 10N
- 500000 FT — 5000-foot grid ticks: California State Plane coordinate system, zone III (FIPSZONE 0403), Lambert Conformal Conic projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
May 18, 2009

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0209H

# FIRM

FLOOD INSURANCE RATE MAP

SANTA CLARA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 209 OF 830
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| CUPERTINO, CITY OF | 060339 | 0209 | H |
| SAN JOSE, CITY OF | 060349 | 0209 | H |
| SANTA CLARA COUNTY | 060337 | 0209 | H |
| SANTA CLARA, CITY OF | 060350 | 0209 | H |
| SUNNYVALE, CITY OF | 060352 | 0209 | H |

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
06085C0209H

EFFECTIVE DATE
MAY 18, 2009

Federal Emergency Management Agency