Proposed Promenade School Site
Dublin Unified School District

Prepared for:

Dublin Unified School District
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Project Number DBSD-01
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1. Introduction

1.1 PURPOSE

This report presents the results of a Pipeline Safety Hazard Assessment (PSHA) prepared for the Dublin Unified School District (District) for the proposed Promenade School Site. The PSHA evaluates potential exposure and fatality risk to staff and students from underground or at-grade natural gas or hazardous liquid pipeline releases and the potential for flooding from high volume water pipelines.

1.2 SCHOOL SITE LOCATION

The project site (site) is a vacant lot located at the southeast corner of Central Parkway and Chancery Lane in the City of Dublin, Alameda County, California (Assessor's Parcel Numbers [APNs] 985-78-2, -3, -4, -5, -6 and -7). The approximate 23-acre site is bounded on the north by Central Parkway, on the east and west by single family residences, and to the south by Dublin Boulevard (Figure 1).

1.3 REGULATORY REQUIREMENTS

Under Education Code Section 17251, the California Department of Education (CDE) has authority to approve acquisition of proposed school sites. The school district must obtain CDE approval for sites to receive state funds under the state's School Facilities Program administered by the State Allocation Board. CDE standards and regulations for this process are presented in California Code of Regulations (CCR), Title 5, Sections 14010, 14011, and 14012. Information on assessing safety hazard related to pipelines is discussed in Section 14010 (h):

The site shall not be located near an above-ground water or fuel storage tank or within 1,500 feet of the easement of an above-ground or underground pipeline that can pose a safety hazard as determined by a risk analysis study, conducted by a competent professional, which may include certification from a local public utility commission.

By CDE policy, “any pipeline that has a maximum operating capacity of at least 80 pounds per square inch (psi), including but not limited to those that carry natural gas, liquid petroleum, fuels or hazardous chemicals, shall be included in a pipeline survey, regardless if the pipeline is classified as a transmission or distribution line. Pipelines located within a railroad or other easement or those pipelines serving gas and oil well sites and fields shall also be included”.

Additional information on pipelines is contained in CDE’s School Site Selection and Approval Guide. This document states that CDE will not approve a proposed school site if the site "contains one or more pipelines, situated underground or aboveground, which carries hazardous substances, acutely hazardous materials, or hazardous wastes, unless the pipeline is a natural gas line which is used only to supply natural gas to that school or neighborhood" (CDE, 2000).
The CDE’s School Site Selection and Approval Guide also contain provisions for evaluating high-pressure water pipelines:

To ensure the protection of students, faculty, and school property if the proposed school site is within 1,500 feet of the easement of an aboveground or underground pipeline that can pose a safety hazard, the school district should obtain the following information from the pipeline owner and operator:

- Pipeline alignment, size, type of pipe, depth of cover
- Operating water pressures in pipelines near the proposed school site
- Estimated volume of water that might be released from the pipeline should a rupture occur on the site
- Owner’s assessment of the structural condition of the pipeline.

1.4 REPORT OBJECTIVES

To meet the requirements of CCR Title 5 Sections 14010 (d) and (h) and CDE’s policy on pipelines, this PSHA is designed to meet the following objectives:

- Identify all natural gas and hazardous liquid pipelines located within 1,500 feet of proposed or existing school sites
- Complete a Stage 1, Stage 2, or Stage 3 risk analysis for each identified pipeline to predict fatality risk
- Where appropriate, identify and develop mitigation measures to reduce predicted fatality risk to a level below an established significance threshold
- Identify all high pressure/high volume water pipelines within 1,500 feet of the proposed school site and evaluate the potential for flooding
- Where appropriate, identify and develop mitigation measures to reduce flooding impacts to acceptable levels.

1.5 ASSESSMENT METHODOLOGY

The CDE has developed and published guidance procedures for evaluating safety hazards associated with natural gas and hazardous liquid releases from underground and aboveground pipelines. A detailed description of the procedures is provided in the Guidance Protocol for School Site Pipeline Risk Analysis (CDE, 2007). These procedures were used in conducting the PSHA.

The PSHA process is composed of two steps. The first step (Stage 1) is a risk screening analysis (RSA), based on the distance of the pipeline(s) from the school site and operating characteristics of the pipeline(s). If the screening criteria are met, the level of risk is acceptable and no further analysis is required.

If the screening criteria are not met, then the second step of the PSHA process is completion of a Stage 2 quantitative risk analysis (QRA). The Stage 2 risk analysis considers pipeline accident rates, school dimensions, conditional probabilities for ignition, school attendance time, and fatality probabilities for different exposure scenarios (pool fire, flash fire, and explosion) to estimate individual risk (IR). Pipelines
located within 50 feet of a school site also are subject to a Stage 3 (more comprehensive) analysis to verify the results of the Stage 2 evaluation.

Individual fatality risk is compared to the significance threshold level of one in one million (1.0 \times 10^{-6}; individual risk criterion, IRC). If the estimated risk is less than one in one million, then no significant safety hazard is predicted for the school site. If the estimated risk is greater than one in one million, mitigation measures are required to reduce risk to within acceptable limits or a more detailed Stage 3 risk analysis can be conducted.

In addition to individual risk, an estimate of the potential risk for the population present at the school site is determined by calculating the total individual risk (TIR) indicator ratio and the population risk indicator. These parameters add an additional perspective by taking into account the site configuration and school population. There is no significance threshold established by the CDE for this evaluation, and this does not replace the IR estimate as the primary decision criteria for evaluating risk at the school site. However, it does provide additional information regarding the magnitude of risk at the school.

The CDE also has developed risk analysis procedures for evaluating flooding associated with releases from large diameter water pipelines, as described in CDE's Guidance Protocol for School Site Pipeline Risk Analysis (CDE, 2007). A safety issue associated with large diameter water pipelines is the potential for flooding. Also, releases from underground water pipelines can cause subterranean erosion of saturated soil, leading to subsidence or formation of a sinkhole. The most likely cause of failure is a large magnitude earthquake and associated strong ground shaking.

Although no specific criteria have been established by the CDE as a threshold of significance for flooding at a school site, a water depth of 12 inches or greater is a trigger that could warrant further evaluation (CDE, 2007).
2. Hazard Assessment

2.1 Pipeline Location and Operational Data

There is one natural gas transmission pipeline within 1,500 feet of the school site. No natural gas distribution pipelines or hazardous liquid pipelines were identified within the 1,500-foot radius (National Pipeline Mapping System, 2018). The location of the pipeline is shown on Figure 1.

Natural gas pipeline data was obtained from Pacific Gas & Electric Company (PG&E, 2018). A 16-inch natural gas transmission pipeline (designated as Distribution Feeder Main 2408-05) is located approximately 1,460 feet south of the project site in the right-of-way immediately south of Interstate 580. The pipeline was installed in 1970 and has a maximum allowable operating pressure (MAOP) of 497 pounds per square inch (psig) for the segment nearest the site. The pipeline is constructed of steel and has a range of wall thickness between 0.219 inch and 0.375 inch. PG&E pipelines are wrapped with tape or extru-coat plastic and equipped with an induced current cathodic protection system to minimize corrosion, and are buried at least 3 feet below ground surface (bgs). The pipeline is patrolled quarterly and leak surveys are conducted annually. Also, the cathodic protection rectifiers are inspected annually and the pipe-to-soil potentials are measured six times per year. The CDE default pipeline length of 5 miles was conservatively used in this analysis because the distance between isolation valves was not provided by PG&E.

The PG&E pipeline is inspected in accordance with Federal (49 Code of Federal Regulations [CFR] 192) and State (California Public Utilities Commission [CPUC] General Order 112-E) regulations. Under Federal and State regulations, the class designation of a pipeline is based on the types of buildings, population density, and level of human activity near the segment of pipeline, and is used to determine the pipeline’s MAOP. Pipelines are rated from Class 1 to Class 4, based on increasing levels of population. Class 3 is defined as any location within 220 yards of the pipeline that contains 46 or more dwellings or an area where the pipeline lies within 100 yards of a building or a small, well-defined outdoor area, such as playgrounds, recreational areas, outdoor theaters, or places of assembly, that are occupied for a specified number of days per year. The allowable MAOP for pipelines in a Class 3 location is no more than 50% of the pipeline’s specified minimum yield strength (SMYS). A Class 3 location also requires more stringent regulations regarding distances between sectionalizing valves, pipe wall thickness, hydrostatic test pressures, inspection and testing of welds, and frequency of pipeline patrols and leak surveys. The 16-inch transmission line is classified as Class 3 at this location.

Based on plans provided from the Dublin San Ramon Services District (DSRSD), there are several high volume (>12 inch diameter) water pipelines within 1,500 feet of the project site, as summarized in Table 1.
2. Hazard Assessment

Table 1 Water Pipelines

<table>
<thead>
<tr>
<th>Pipeline Diameter</th>
<th>Pipeline Location</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-inch</td>
<td>Gleason Drive</td>
<td>Dublin San Ramon Services District (DSRSD)</td>
</tr>
<tr>
<td>12-inch</td>
<td>Grafton Street</td>
<td>DSRSD</td>
</tr>
<tr>
<td>12-inch</td>
<td>Central Parkway</td>
<td>DSRSD</td>
</tr>
<tr>
<td>12-inch</td>
<td>Brannigan Street</td>
<td>DSRSD</td>
</tr>
<tr>
<td>20-inch</td>
<td>Dublin Boulevard</td>
<td>DSRSD</td>
</tr>
<tr>
<td>16-inch</td>
<td>Dublin Boulevard</td>
<td>DSRSD</td>
</tr>
<tr>
<td>14-inch</td>
<td>Dublin Boulevard, south driveway entrance to site</td>
<td>DSRSD</td>
</tr>
<tr>
<td>14-inch</td>
<td>Dublin Boulevard, east of Keegan Street</td>
<td>DSRSD</td>
</tr>
<tr>
<td>12-inch</td>
<td>Grafton Street, south of Dublin Boulevard</td>
<td>DSRSD</td>
</tr>
<tr>
<td>14-inch</td>
<td>Gleason Drive – Recycled Water Pipeline</td>
<td>DSRSD</td>
</tr>
<tr>
<td>14-inch</td>
<td>Grafton Street – Recycled Water Pipeline</td>
<td>DSRSD</td>
</tr>
<tr>
<td>12-inch</td>
<td>Central Parkway – Recycled Water Pipeline</td>
<td>DSRSD</td>
</tr>
<tr>
<td>20-inch</td>
<td>Dublin Boulevard - Recycled Water Pipeline</td>
<td>DSRSD</td>
</tr>
<tr>
<td>12-inch</td>
<td>Dublin Boulevard - Recycled Water Pipeline</td>
<td>DSRSD</td>
</tr>
</tbody>
</table>

The locations of the water pipelines are shown on Figure 1, and an evaluation of flooding potential with respect to the school site is provided in Section 2.6.

2.2 LAND USE AND TERRAIN

Surrounding land uses consist of existing residential, recreational, and retail uses. There are several buildings or structures that could partially block or buffer vapor releases or jet flames if an incident were to occur involving the natural gas pipeline south of the site. Potential ignition sources may include motor vehicles traveling along the adjacent streets, traffic signals, overhead high voltage electrical lines, and residential gas heating units.

2.3 RELEASE AND CONSEQUENCE SCENARIOS

In accordance with the CDE Guidance Protocol, two conservative release scenarios were evaluated for the natural gas pipeline: 1) a rupture or high volume release equal to the pipeline’s diameter, and 2) a leak or small volume release from a 1-inch diameter hole. Three potential consequences were evaluated for each release scenario: 1) jet flame, 2) flash fire (flammable vapor cloud), and 3) explosion. Results from the ALOHA computer analyses indicate that unconfined vapor cloud explosions would not occur in an open environment (i.e., residential land use setting) and this scenario was not subject to further analysis.
2. Hazard Assessment

2.4 STAGE 1 RISK ANALYSIS

The Stage 1 screening analysis was conducted for the 16-inch natural gas transmission pipeline, as listed in Table 2. The criterion for a Stage 1 screening analysis was not met because the MAOP for the natural gas pipeline is higher than 400 psig. Therefore, a Stage 2 risk analysis was conducted to determine the cumulative individual risk (IR) to students and staff at the proposed school.

Table 2 Stage 1 Screening Analysis

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Stage 1 Criteria</th>
<th>Meets Criteria?</th>
<th>Site Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of pipelines within 1,500 foot radius</td>
<td>One</td>
<td>Yes</td>
<td>One</td>
</tr>
<tr>
<td>Segment length within 1,500 foot radius</td>
<td>1,000 feet or less</td>
<td>Yes</td>
<td>600 feet</td>
</tr>
<tr>
<td>Pipeline diameter</td>
<td>≤ 24 inches</td>
<td>Yes</td>
<td>16 inches</td>
</tr>
<tr>
<td>Maximum pressure</td>
<td>≤ 400 psi</td>
<td>No</td>
<td>497 psi</td>
</tr>
<tr>
<td>Pipeline distance from project site</td>
<td>&gt; 600 feet</td>
<td>Yes</td>
<td>1,460 feet</td>
</tr>
<tr>
<td>Pipeline failure rate</td>
<td>&lt; 1.2E-04</td>
<td>Yes</td>
<td>1.2E-04</td>
</tr>
</tbody>
</table>

2.5 STAGE 2 RISK CALCULATION RESULTS

Risk calculation results for the natural gas pipeline are provided in Appendix A. The results indicate that the hazard footprints for this pipeline do not extend farther than 897 feet and would not reach the school site, which is approximately 1,460 feet from the pipeline. Therefore, in accordance with CDE procedures, the risk is considered to be less than significant and no further evaluation is required.

2.6 WATER PIPELINE FLOODING ANALYSIS

In addition to natural gas and hazardous liquid pipelines, the CDE requires that the risk of releases from high volume (>12 inches) water pipelines be evaluated. The CDE Guidance Protocol for School Pipeline Risk Analysis provides a methodology for evaluating the potential for flooding. A probability analysis is not required.

For identified water pipelines located beneath a street, a pipeline flooding analysis was conducted to determine the depth and location of water flow within the street in the event of a pipeline leak or rupture. For this worst-case analysis, it was conservatively assumed that all of the water flowing through the pipelines at their maximum capacity would reach the surface. In addition, no credit was taken for the presence of storm drains along these streets.

Release impacts were calculated based on the procedures specified in the CDE manual. The release rate was determined by multiplying the pipe area by an assumed velocity of 5 feet per second (fps). Then the release rate was compared to the carrying capacity of the street, taking into account longitudinal slope, to determine if the water would be contained within the confines of the street curbing (Jeffers & Associates, 2006). The results are provided in Table 3.
### 2. Hazard Assessment

#### Table 3  Water Pipeline Flooding Analysis – Street Flow

<table>
<thead>
<tr>
<th>Pipeline Diameter</th>
<th>Pipeline Location</th>
<th>Release Rate (cfs)</th>
<th>Street Width (ft)</th>
<th>Depth of Flow in Street (in)</th>
<th>Exceeds Street Carrying Capacity?</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-inch</td>
<td>Gleason Drive</td>
<td>3.93</td>
<td>78</td>
<td>2.9</td>
<td>No</td>
</tr>
<tr>
<td>12-inch</td>
<td>Grafton Street</td>
<td>3.93</td>
<td>52</td>
<td>2.5</td>
<td>No</td>
</tr>
<tr>
<td>12-inch</td>
<td>Central Parkway</td>
<td>3.93</td>
<td>84</td>
<td>3.6</td>
<td>No</td>
</tr>
<tr>
<td>12-inch</td>
<td>Brannigan Street</td>
<td>3.93</td>
<td>38</td>
<td>3.3</td>
<td>No</td>
</tr>
<tr>
<td>20-inch</td>
<td>Dublin Boulevard</td>
<td>10.91</td>
<td>122</td>
<td>5.2</td>
<td>No</td>
</tr>
<tr>
<td>16-inch</td>
<td>Dublin Boulevard</td>
<td>6.98</td>
<td>122</td>
<td>4.4</td>
<td>No</td>
</tr>
<tr>
<td>14-inch</td>
<td>Dublin Boulevard, south driveway entrance to site</td>
<td>5.34</td>
<td>122</td>
<td>4.0</td>
<td>No</td>
</tr>
<tr>
<td>14-inch</td>
<td>Dublin Boulevard, east of Keegan Street</td>
<td>5.34</td>
<td>104</td>
<td>4.0</td>
<td>No</td>
</tr>
<tr>
<td>12-inch</td>
<td>Grafton Street, south of Dublin Boulevard</td>
<td>3.93</td>
<td>76</td>
<td>3.4</td>
<td>No</td>
</tr>
<tr>
<td>14-inch</td>
<td>Gleason Drive – Recycled Water Pipeline</td>
<td>5.34</td>
<td>78</td>
<td>3.2</td>
<td>No</td>
</tr>
<tr>
<td>14-inch</td>
<td>Grafton Street – Recycled Water Pipeline</td>
<td>5.34</td>
<td>52</td>
<td>2.8</td>
<td>No</td>
</tr>
<tr>
<td>12-inch</td>
<td>Central Parkway - Recycled Water Pipeline</td>
<td>3.93</td>
<td>84</td>
<td>3.6</td>
<td>No</td>
</tr>
<tr>
<td>20-inch</td>
<td>Dublin Boulevard - Recycled Water Pipeline</td>
<td>10.91</td>
<td>122</td>
<td>5.2</td>
<td>No</td>
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<tr>
<td>12-inch</td>
<td>Dublin Boulevard - Recycled Water Pipeline</td>
<td>3.93</td>
<td>122</td>
<td>3.6</td>
<td>No</td>
</tr>
</tbody>
</table>

Assuming a standard 6-inch curb for residential streets, the water released from a full-flow rupture of any of the water mains would be entirely contained within the confines of the curbing and would not result in flooding at the school site.
2.7 SUMMARY AND RECOMMENDATIONS

The results of the Stage 2 screening analysis indicate that the hazard footprints for the 16-inch natural gas transmission pipeline do not reach the school site, and would not pose a risk to students or staff at the proposed school site. If a rupture or leak should occur in the water mains within 1,500 feet of the school site, the results of the flooding analysis indicate that the released water would not result in water depths at the school site that would pose a risk to students and staff.

Even though the impact of pipeline releases was found to be less than significant, it is recommended that the school’s emergency response and evacuation plan address the possibility of natural gas or water pipeline releases and identify potential evacuation routes. Also, contact names and numbers for the natural gas provider and water agencies (Pacific Gas and Electric Company and Dublin San Ramon Services District) should be maintained with the emergency response plan in case the school needs to report pipeline releases. A map of the pipeline locations and emergency contact information should be kept with the school’s emergency response plan.
3. References


Dublin San Ramon Services District (DSRSD), 2018. Pipeline information and map provided by Mr. Roper Macaraeg, Engineering Tech/GIS Specialist I, for DSRSD to Ms. Danielle Clendening, Intern, PlaceWorks. Dated August 2, 2018.


Pacific Gas & Electric (PG&E) Company, 2018. Pipeline information and map provided by Mr. Steven Liu, Gas Technical Specialist, for PG&E to Ms. Danielle Clendening, Intern, PlaceWorks. Dated June 29, 2018.

Figure 1
Site Location and Pipeline Map
Appendix A. CDE Risk Analysis Summary Forms and Calculations
### Local Educational Agency

<table>
<thead>
<tr>
<th>Date:</th>
<th>August 20, 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Educational Agency</td>
<td>Dublin Unified School District</td>
</tr>
<tr>
<td>Contact</td>
<td>Mr. Joe Sorrera – Assistant Superintendent</td>
</tr>
<tr>
<td>Telephone Number</td>
<td>925.828.2551</td>
</tr>
<tr>
<td>E-mail address</td>
<td><a href="mailto:sorrerajoe@dublinusd.org">sorrerajoe@dublinusd.org</a></td>
</tr>
<tr>
<td>Street Address</td>
<td>7471 Larkdale Avenue</td>
</tr>
<tr>
<td>City</td>
<td>Dublin</td>
</tr>
<tr>
<td>County</td>
<td>Alameda County</td>
</tr>
<tr>
<td>Zip Code</td>
<td>94568</td>
</tr>
</tbody>
</table>

### Proposed School Campus Site

<table>
<thead>
<tr>
<th>Name</th>
<th>Promenade School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location Description</td>
<td>Vacant lot at southeast corner of Central Parkway and Chancery Lane Dublin, CA 94568</td>
</tr>
<tr>
<td>Pipelines of Interest</td>
<td>One natural gas transmission pipeline</td>
</tr>
<tr>
<td>Operator/Owner</td>
<td>Pacific Gas and Electric Company</td>
</tr>
<tr>
<td>Product Transported</td>
<td>Natural Gas</td>
</tr>
<tr>
<td>Pipeline Diameter (inches)</td>
<td>16-inch</td>
</tr>
<tr>
<td>Operating Pressure (psig)</td>
<td>497 psig</td>
</tr>
<tr>
<td>Closest Approach to Property Line</td>
<td>1,460 feet</td>
</tr>
</tbody>
</table>

### Individual Risk Estimate Result

<table>
<thead>
<tr>
<th>Type of Analysis (Check One)</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>X</th>
<th>Stage 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Risk Estimate Value</td>
<td>Zero (hazard footprints don't reach school site)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual Risk Criterion</td>
<td>1.0E-06 (0.0000001)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IR Significance (check one)</th>
<th>Significant</th>
<th>X</th>
<th>Insignificant</th>
</tr>
</thead>
</table>

### Certification and Signatures of Risk Analyst(s)

This analysis was conducted according to the 2007 CDE Protocol except as noted. All modifications within the Stage 2 framework, and exceptions to the data and processes established in the 2007 CDE Protocol, if any, were based upon my professional opinion and in a manner consistent with the standards of care and skill ordinarily exercised by professionals working on similar projects.

I certify that the estimated risk levels were derived based upon the 2007 CDE Protocol, unless otherwise noted, and that these levels demonstrate, with reasonable expectations of uncertainties for such estimates, that the estimated Individual Risk for the school site, as the site was planned at the time of this analysis, including mitigation measures, if any, meets the Individual Risk Criterion stated in the 2007 CDE Protocol, based on the information provided to me.

<table>
<thead>
<tr>
<th>Printed Name</th>
<th>Signature</th>
<th>Position or Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steven J. Bush, P.E.</td>
<td>![Signature]</td>
<td>Senior Engineer</td>
</tr>
</tbody>
</table>

**Notice:** In the event that the Individual Risk Criterion could not be met, at the option of the LEA, CDE will still accept a report for review and consultation with the LEA.
### Input Data

<table>
<thead>
<tr>
<th>Product</th>
<th>Natural gas</th>
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<tbody>
<tr>
<td>Diameter</td>
<td>16 inches</td>
</tr>
<tr>
<td>Pressure</td>
<td>497 psig</td>
</tr>
<tr>
<td>R0</td>
<td>1460 ft</td>
</tr>
</tbody>
</table>

### XSEG | RX(1%) | Units |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>XSEG(LJF)</td>
<td>0</td>
<td>ft</td>
</tr>
<tr>
<td>XSEG(RJF)</td>
<td>0</td>
<td>ft</td>
</tr>
<tr>
<td>XSEG(LFF)</td>
<td>0</td>
<td>ft</td>
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<tr>
<td>XSEG(RFF)</td>
<td>0</td>
<td>ft</td>
</tr>
<tr>
<td>XSEG(LEX)</td>
<td>0</td>
<td>ft</td>
</tr>
<tr>
<td>XSEG(REX)</td>
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<td>ft</td>
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### Base and Conditional Probability Calculations

<table>
<thead>
<tr>
<th>Base</th>
<th>Leak</th>
<th>Rupture</th>
<th>Exposure</th>
</tr>
</thead>
<tbody>
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<td>F0</td>
<td>1.2E-04</td>
<td>0.80</td>
<td>0.20</td>
</tr>
<tr>
<td>P0</td>
<td>1.2E-04</td>
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<td>0.45</td>
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<tr>
<td>PAF</td>
<td>1.0</td>
<td>0.99</td>
<td>0.99</td>
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<tr>
<td>PA</td>
<td>1.2E-04</td>
<td>0.98</td>
<td>0.98</td>
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<tr>
<td></td>
<td>PC(L)</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>PC(R)</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>PC(LJF)</td>
<td>0.233</td>
<td>0.087</td>
</tr>
<tr>
<td></td>
<td>PC(RJF)</td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>PC(LFF)</td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>PC(RFF)</td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>PC(LEX)</td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>PC(REX)</td>
<td>0.002</td>
<td>0.001</td>
</tr>
</tbody>
</table>

**Calculated Values:**

- PC(LJF) = 0.0E+00  PCI(LJF) = 0.233  PC(RJF) = 0.002  PC(REX) = 0.002
- PC(RJF) = 0.0E+00  PCI(RJF) = 0.002  PC(RFF) = 0.002  PC(REX) = 0.002
- PC(LFF) = 0.0E+00  PCI(LFF) = 0.002  PC(RFF) = 0.002  PC(REX) = 0.002
- PC(RFF) = 0.0E+00  PCI(RFF) = 0.002  PC(REX) = 0.002  PC(REX) = 0.002
- PC(LEX) = 0.0E+00  PCI(LEX) = 0.002  PC(REX) = 0.002  PC(REX) = 0.002

### Impact Probability Calculations

<table>
<thead>
<tr>
<th>Probability Term</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC(LJF) = PA(LJF) x PCI(LJF) x PC(EXPO)</td>
<td>0.0E+00 0.23 0.040 0.0E+00</td>
</tr>
<tr>
<td>PC(RJF) = PA(RJF) x PCI(RJF) x PC(EXPO)</td>
<td>0.0E+00 0.09 0.040 0.0E+00</td>
</tr>
<tr>
<td>PC(LFF) = PA(LFF) x PCI(LFF) x PC(EXPO)</td>
<td>0.0E+00 0.002 0.040 0.0E+00</td>
</tr>
<tr>
<td>PC(RFF) = PA(RFF) x PCI(RFF) x PC(EXPO)</td>
<td>0.0E+00 0.001 0.040 0.0E+00</td>
</tr>
<tr>
<td>PC(LEX) = PA(LEX) x PCI(LEX) x PC(EXPO)</td>
<td>0.0E+00 0.002 0.040 0.0E+00</td>
</tr>
<tr>
<td>PC(REX) = PA(REX) x PCI(REX) x PC(EXPO)</td>
<td>0.0E+00 0.001 0.040 0.0E+00</td>
</tr>
</tbody>
</table>

Based on data from impact distance figures in Section 4.6 and mortality figures in Section 4.5, enter the maximum impact probability at receptor location for each hazard in MAX PF(X) column.

### IR Calculation

<table>
<thead>
<tr>
<th>MAX PF(X)</th>
<th>PC(X)</th>
<th>IR(X)</th>
</tr>
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<tbody>
<tr>
<td>IR(LJF) = 1.00</td>
<td>0.0E+00</td>
<td>0.00E+00</td>
</tr>
<tr>
<td>IR(RJF) = 1.00</td>
<td>0.0E+00</td>
<td>0.00E+00</td>
</tr>
<tr>
<td>IR(LFF) = 1.00</td>
<td>0.0E+00</td>
<td>0.00E+00</td>
</tr>
<tr>
<td>IR(RFF) = 1.00</td>
<td>0.0E+00</td>
<td>0.00E+00</td>
</tr>
<tr>
<td>IR(LEX) = 0.00</td>
<td>0.0E+00</td>
<td>0.00E+00</td>
</tr>
<tr>
<td>IR(REX) = 0.00</td>
<td>0.0E+00</td>
<td>0.00E+00</td>
</tr>
</tbody>
</table>

**TOTAL INDIVIDUAL RISK, TIR** 0.0E+00

**CDE INDIVIDUAL RISK CRITERION, IRC** 1.0E-06

**TIR/IRC RATIO** 0.00

**PROTOCOL TIR INDICATOR RATIO** 0.00

Hazard footprints do not reach the school site.
## XSEG Calculations

<table>
<thead>
<tr>
<th>Pipe Size, Pressure, and Hazard Type</th>
<th>Front Property Line - Begin Zone 1</th>
<th>Begin Zone 2</th>
<th>Begin Zone 3</th>
<th>End Zone 3 - Back Property Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Size (in)</td>
<td>Press. (psig)</td>
<td>Hazard X RX (1%)</td>
<td>R0 (ft)</td>
<td>XSEG (ft)</td>
</tr>
<tr>
<td>16 497</td>
<td>LJF</td>
<td>33 1460</td>
<td>0 33</td>
<td>2010</td>
</tr>
<tr>
<td>16 497</td>
<td>RJF</td>
<td>222 1460</td>
<td>0 222</td>
<td>2010</td>
</tr>
<tr>
<td>16 497</td>
<td>LFF</td>
<td>132 1460</td>
<td>0 132</td>
<td>2010</td>
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<tr>
<td>16 497</td>
<td>RFF</td>
<td>897 1460</td>
<td>0 897</td>
<td>2010</td>
</tr>
<tr>
<td>16 497</td>
<td>LEX</td>
<td>0 1460</td>
<td>0 0</td>
<td>2010</td>
</tr>
<tr>
<td>16 497</td>
<td>REX</td>
<td>0 1460</td>
<td>0 0</td>
<td>2010</td>
</tr>
</tbody>
</table>
SITE DATA:
Location: DUBLIN, CALIFORNIA
Building Air Exchanges Per Hour: 0.63 (unsheltered single storied)
Time: August 3, 2018  1256 hours PDT (using computer's clock)

CHEMICAL DATA:
Chemical Name: METHANE
CAS Number: 74-82-8 Molecular Weight: 16.04 g/mol
PAC-1: 65000 ppm  PAC-2: 230000 ppm  PAC-3: 400000 ppm
LEL: 50000 ppm  UEL: 150000 ppm
Ambient Boiling Point: -259.0° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 3 meters/second from W at 3 meters
Ground Roughness: urban or forest Cloud Cover: 5 tenths
Air Temperature: 77° F Stability Class: D
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Flammable gas is burning as it escapes from pipe
Pipe Diameter: 16 inches  Pipe Length: 26400 feet
Unbroken end of the pipe is closed off
Pipe Roughness: smooth  Hole Area: 0.785 sq in
Pipe Press: 511.7 psia Pipe Temperature: 77° F
Max Flame Length: 2 yards
Burn Duration: ALOHA limited the duration to 1 hour
Max Burn Rate: 389 pounds/min
Total Amount Burned: 18,735 pounds

THREAT ZONE:
Threat Modeled: Thermal radiation from jet fire
Red : less than 10 meters(10.9 yards) --- (15.77 kW/(sq m))
SITE DATA:
Location: DUBLIN, CALIFORNIA
Building Air Exchanges Per Hour: 0.63 (unsheltered single storied)
Time: August 3, 2018 1256 hours PDT (using computer's clock)

CHEMICAL DATA:
Chemical Name: METHANE
CAS Number: 74-82-8 Molecular Weight: 16.04 g/mol
PAC-1: 65000 ppm PAC-2: 230000 ppm PAC-3: 400000 ppm
LEL: 50000 ppm UEL: 150000 ppm
Ambient Boiling Point: -259.0° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 3 meters/second from W at 3 meters
Ground Roughness: urban or forest Cloud Cover: 5 tenths
Air Temperature: 77° F Stability Class: D
No Inversion Height Relative Humidity: 50%

SOURCE STRENGTH:
Flammable gas is burning as it escapes from pipe
Pipe Diameter: 16 inches Pipe Length: 26400 feet
Unbroken end of the pipe is connected to an infinite source
Pipe Roughness: smooth Hole Area: 201 sq in
Pipe Press: 511.7 psia Pipe Temperature: 77° F
Max Flame Length: 45 yards
Burn Duration: ALOHA limited the duration to 1 hour
Max Burn Rate: 99,700 pounds/min
Total Amount Burned: 549,037 pounds

THREAT ZONE:
Threat Modeled: Thermal radiation from jet fire
Red : 74 yards --- (15.77 kW/(sq m))
SITE DATA:
Location: DUBLIN, CALIFORNIA
Building Air Exchanges Per Hour: 0.63 (unsheltered single storied)
Time: August 3, 2018  1256 hours PDT (using computer's clock)

CHEMICAL DATA:
Chemical Name: METHANE
CAS Number: 74-82-8  Molecular Weight: 16.04 g/mol
PAC-1: 65000 ppm  PAC-2: 230000 ppm  PAC-3: 400000 ppm
LEL: 50000 ppm  UEL: 150000 ppm
Ambient Boiling Point: -259.0° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 3 meters/second from W at 3 meters
Ground Roughness: urban or forest  Cloud Cover: 5 tenths
Air Temperature: 77° F  Stability Class: D
No Inversion Height  Relative Humidity: 50%

SOURCE STRENGTH:
Flammable gas escaping from pipe (not burning)
Pipe Diameter: 16 inches  Pipe Length: 26400 feet
Unbroken end of the pipe is closed off
Pipe Roughness: smooth  Hole Area: 0.785 sq in
Pipe Press: 511.7 psia  Pipe Temperature: 77° F
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 375 pounds/min
(averaged over a minute or more)
Total Amount Released: 18,735 pounds

THREAT ZONE:
Threat Modeled: Flammable Area of Vapor Cloud
Model Run: Gaussian
Red  : 44 yards --- (50000 ppm = LEL)
Note: Threat zone was not drawn because effects of near-field patchiness
make dispersion predictions less reliable for short distances.
SITE DATA:
Location: DUBLIN, CALIFORNIA
Building Air Exchanges Per Hour: 0.63 (unsheltered single storied)
Time: August 3, 2018  1256 hours PDT (using computer's clock)

CHEMICAL DATA:
Chemical Name: METHANE
CAS Number: 74-82-8                    Molecular Weight: 16.04 g/mol
PAC-1: 65000 ppm   PAC-2: 230000 ppm   PAC-3: 400000 ppm
LEL: 50000 ppm     UEL: 150000 ppm
Ambient Boiling Point: -259.0° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 3 meters/second from W at 3 meters
Ground Roughness: urban or forest      Cloud Cover: 5 tenths
Air Temperature: 77° F                 Stability Class: D
No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
Flammable gas escaping from pipe (not burning)
Pipe Diameter: 16 inches               Pipe Length: 26400 feet
Unbroken end of the pipe is connected to an infinite source
Pipe Roughness: smooth                 Hole Area: 201 sq in
Pipe Press: 511.7 psia                 Pipe Temperature: 77° F
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 16,500 pounds/min
    (averaged over a minute or more)
Total Amount Released: 549,037 pounds

THREAT ZONE:
Threat Modeled: Flammable Area of Vapor Cloud
Model Run: Gaussian
Red : 299 yards --- (50000 ppm = LEL)
Modified Manning's Equation Solver

Parameters: Composite Triangular Sections | Head - Discharge Table | Assumptions | Inlet Geometry | Disclaimer

Flowline offset: 39.0 ft to top face

Spread: 10.53 ft

W - lip to flowline: 17.0 in.

Depth:
- d: 0.24 ft
- Long. slope: 0.0190 (ft/ft)
- N value: 0.016
- 2.9 in.

Sw: 4.16 %, a: 0.031 ft

Gutter Depression:
- lip to flowline: 0.059 ft

Crown Line - Lateral boundary to half-street flow

Crown: 0.81 ft

Local Parameters:
- Local inlet flow line depression: 2.0 in.
- C-O Apron wider than gutter: 0 in.

Curb Opening Parameters:
- Length of curb opening inlet: 12.0 ft
- Lc: 19.39 ft

Sw: 13.9 %, Se: 6.85 %

% Factor: 50 of % Factor: 50

Splashover Vel: 7.41 ft/s, Vel over grate: 3.96 ft/s

Rs: 5.40 %, Rf: 100.00 %

Side flow captured: 0.03 cfs, Frontal captured: 0.57 cfs

Total combined CB flowby: 0.55 cfs

Street Parameters:
- Q: 3.93 cfs
- K: 28.5
- Vel: 3.48 ft/s
- Eo: 34.8 %
- W/T: 0.1345

Standard Manning's:
- Q: 3.22 cfs
- K: 23.3
- Vel: 2.85 ft/s
- Rh: 0.10 ft
- Area: 1.13 sf

P-1-7/8-4

Grate Parameters:
- Apron wider than grate: 2 in.

Street Flow - Gleason Drive
12-Inch Water Main
Street Flow - Central Parkway
12-Inch Water Main and
12-Inch Recycled Water Pipeline
Street Flow - Brannigan Street
12-Inch Water Main
Street Flow - Dublin Boulevard
20-Inch Water Main and
20-Inch Recycled Water Pipeline
Street Flow - Dublin Boulevard
16-Inch Water Main
Street Flow - Dublin Boulevard, driveway 14-Inch Water Main
Street Flow - Dublin Boulevard, east of Keegan Street 14-Inch Water Main
Street Flow - Grafton Street, south of Dublin Boulevard 12-Inch Water Main
Street Flow - Gleason Drive
14-Inch Recycled Water Pipeline
Modified Manning's Equation Solver

Parameters: Composite Triangular Sections | Head - Discharge Table | Assumptions | Inlet Geometry | Disclaimer

Street Parameters:
- Q: 5.34 cfs
- K: 25.2
- Vet: 5.19 ft/s
- Eo: 36.4 %
- W/T: 0.1411

Standard Manning's:
- Q: 4.37 cfs
- K: 20.6
- Vel: 4.25 ft/s
- Rh: 0.10 ft
- Area: 1.03 sf

Depth:
- d: 0.23 ft
- 2.8 in.

Flow line - Lateral boundary to half-street flow:
- Flowline offset: 26.0 ft to top face
- Sx: 2.00%
- Crown: 0.55 ft

Crown Line - Lateral boundary to half-street flow:

W - lip to flowline:
- 17.0 in.

Spread:
- 10.04 ft

Depth:
- Sw: 4.16 %
- a: 0.031 ft
- Gutter Depression - lip to flowline: 0.059 ft

Local Parameters:
- Local inlet flow line depression: 2.0 in.

Curb Opening Parameters:
- C-O Apron wider than gutter: 0 in.

Grate Parameters:
- Apron wider than grate: 2 in.

Street Flow - Grafton Street
14-Inch Recycled Water Pipeline
Street Flow - Dublin Boulevard 12-Inch Recycled Water Pipeline
Appendix B. Agency Correspondence
Pipelines depicted on this map represent gas transmission and hazardous liquid lines only. Gas gathering and gas distribution systems are not represented.

This map should never be used as a substitute for contacting a one-call center prior to excavation activities. Please call 811 before any digging occurs.

Questions regarding this map or its contents can be directed to npms@dot.gov.

Projection: Geographic
Datum: NAD83
Map produced by the Public Viewer application at www.npms.phmsa.dot.gov
Date Printed: Aug 03, 2018
### Questionnaire For Natural Gas Pipeline Risk Analysis Study

**Subject Property:** Central Pkwy and Chancery Ln Dublin, CA 94568

<table>
<thead>
<tr>
<th>1</th>
<th>Pipeline Reference (identification, line no., etc.):</th>
<th>2408-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a. Type: (Distribution, Gathering or Transmission):</td>
<td>Distribution Feeder Main</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Date of Installation (Year):</td>
<td>1970</td>
</tr>
<tr>
<td>3</td>
<td>Maximum Allowable Operating Pressure (psig):</td>
<td>497</td>
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<tr>
<td>3a. Normal Operation Pressure (MOP)</td>
<td>497</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Diameter (inches):</td>
<td>16</td>
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<td>5</td>
<td>Construction / Wall Thickness (steel, plastic/inches):</td>
<td>Steel / .219</td>
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<tr>
<td>6</td>
<td>Corrosion Prevention (cathodic protection, tape, etc.):</td>
<td>Cathodic</td>
</tr>
<tr>
<td>7</td>
<td>% of Specified Minimum Yield Strength (MAOP):</td>
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<td>8</td>
<td>Classification (Present) (1,2,3 or 4)</td>
<td>3</td>
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<td>9</td>
<td>Inspection/Testing Results (method, date, etc.):</td>
<td>Per CPUC 112E</td>
</tr>
<tr>
<td>10</td>
<td>History of Incidents:</td>
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<tr>
<td>11</td>
<td>Pipeline Location Map within 1,500 feet of subject Property:</td>
<td>Attached</td>
</tr>
</tbody>
</table>

1 Pipeline Reference (identification, line no., etc.): 2408-05

1a. Type: (Distribution, Gathering or Transmission): Distribution Feeder Main

2 Date of Installation (Year): 1970

3 Maximum Allowable Operating Pressure (psig): 497

3a. Normal Operation Pressure (MOP): 497
<table>
<thead>
<tr>
<th></th>
<th>Diameter (inches):</th>
<th>16</th>
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<tbody>
<tr>
<td>5</td>
<td>Construction / Wall Thickness (steel, plastic/ounces):</td>
<td>Steel / .312</td>
</tr>
<tr>
<td>6</td>
<td>Corrosion Prevention (cathodic protection, tape, etc.):</td>
<td>Cathodic</td>
</tr>
<tr>
<td>7</td>
<td>% of Specified Minimum Yield Strength (MAOP):</td>
<td>60.68</td>
</tr>
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<td>8</td>
<td>Classification (Present) (1,2,3 or 4)</td>
<td>3</td>
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<td>Inspection/Testing Results (method, date, etc.):</td>
<td>Per CPUC 112E</td>
</tr>
<tr>
<td>10</td>
<td>History of Incidents:</td>
<td>N/A</td>
</tr>
<tr>
<td>11</td>
<td>Pipeline Location Map within 1,500 feet of subject Property:</td>
<td>Attached</td>
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</tbody>
</table>

QUESTIONNAIRE COMPLETED BY:

<table>
<thead>
<tr>
<th>NAME:</th>
<th>Steven Liu</th>
<th>SIGNATURE:</th>
<th><a href="mailto:s3lg@pge.com">s3lg@pge.com</a></th>
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</thead>
<tbody>
<tr>
<td>TITLE:</td>
<td>Gas Technical Specialist</td>
<td>DATE:</td>
<td>6/29/2018</td>
</tr>
<tr>
<td>COMPANY:</td>
<td>PG&amp;E</td>
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