Appendix 6E

Description of CHARM® and Examples of Fire Modeling

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Description of CHARM® and Examples of Fire Modeling

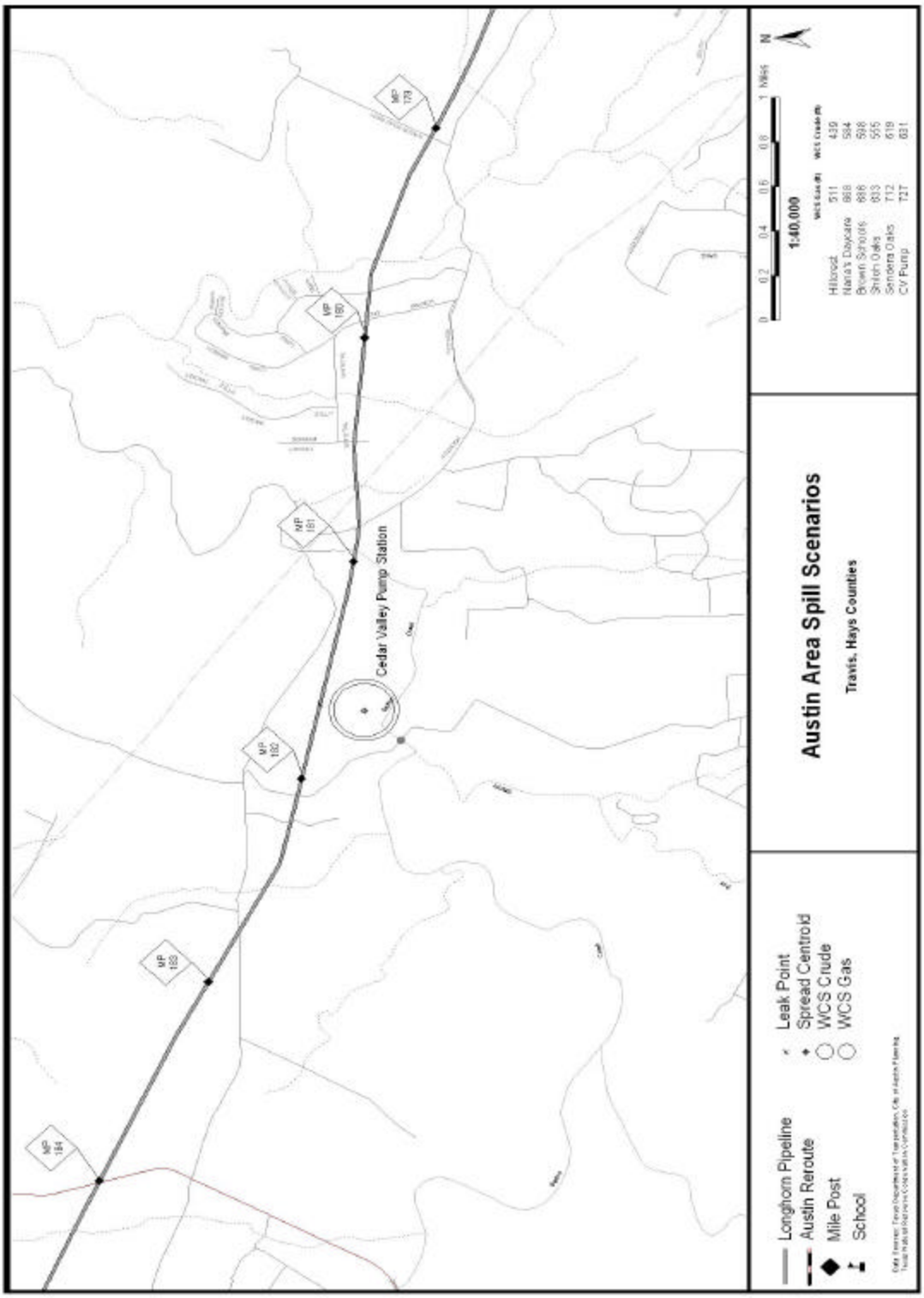
URS Radian's Complex Hazardous Air Release Model (CHARM®) provides an accurate method of assessing potential impacts from airborne releases, pool and jet fires, fireball/BLEVE's, and unconfined vapor cloud explosions. CHARM is a non-gaussian "puff" model that differentiates and integrates small source term emission puffs across time. As a puff model, CHARM is especially suited for modeling short-term accidental releases with time-varying release rates. CHARM simulates gases that are lighter-than-air, dense gases, or neutrally buoyant releases. CHARM is a chemical-specific model with an interface the AIChE DIPPR database which provides access to the physical properties of over 1,500 pure chemicals.

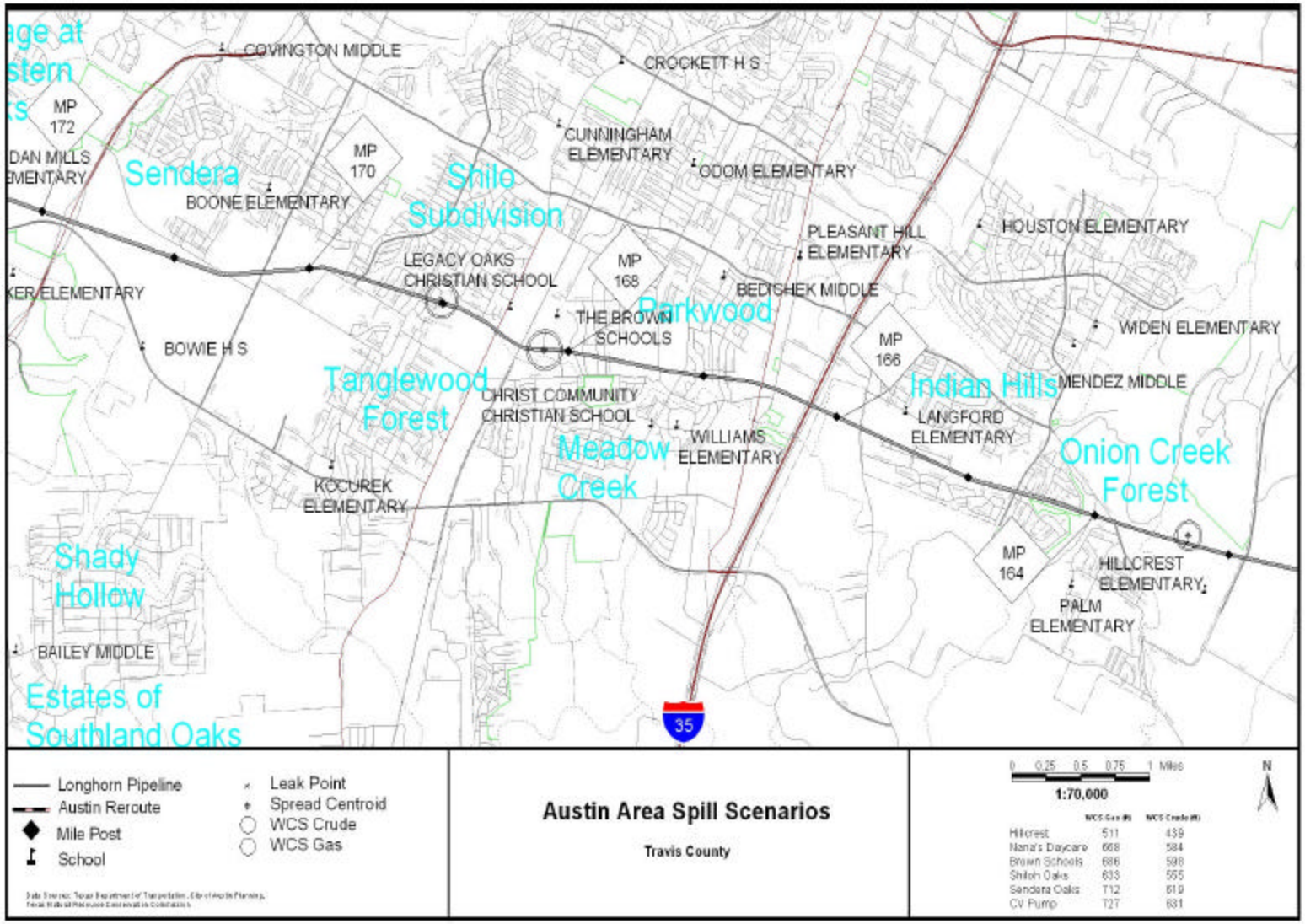
CHARM features extensive calculation modules which can predict initial release conditions (release rate, temperature, phase, density) based on input of containment conditions (temperature, pressure, etc.) and release size. Alternatively, initial release conditions can be input directly to CHARM for dispersion analysis. Vapor cloud explosions are simulated by invoking the overpressure or radiation effects options at any time following the simulated release. CHARM features extremely flexible output capabilities that allow the user to easily examine releases as a function of concentration, distance, and time.

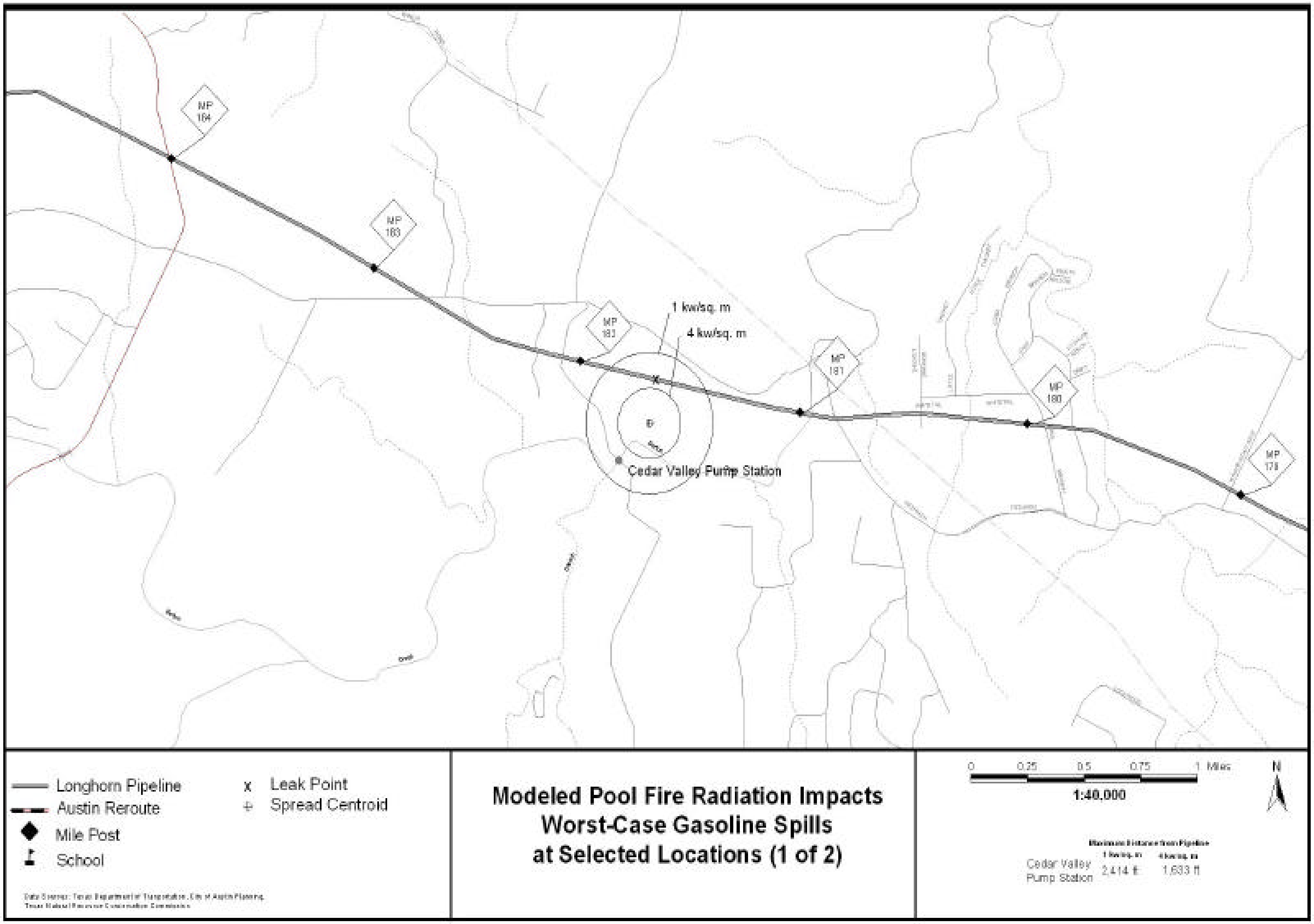
CHARM is widely recognized as an accurate and easy-to-use predictive tool, and is widely accepted by various state and local regulatory agencies. The program has received excellent reviews in field validation studies conducted and documented by the EPA and AIChE[1,2,3]. Although the EPA does not sanction any specific commercial accidental release model(s), CHARM was successfully reviewed as an accurate model in a recent EPA study entitled "Evaluation of Dense Gas Simulation Models"[4]. The 1991 EPA report compared DEGADIS, SLAB, AIRTOX, CHARM, FOCUS, and TRACE models against actual observed results from release tests. The report concluded that:

> "Among the models evaluated in this study, none demonstrated good performance for all three experimental programs (all three actual test chemicals released). Different models performed more effectively for different release scenarios, reflecting the advantages and disadvantages of the various design features that characterize each model. Over all three test programs, two models, CHARM and TRACE provided agreement within a factor of two for more than half of the observed and predicted maximum values, while DEGADIS and SLAB provided the best performance for (only) one experimental program."

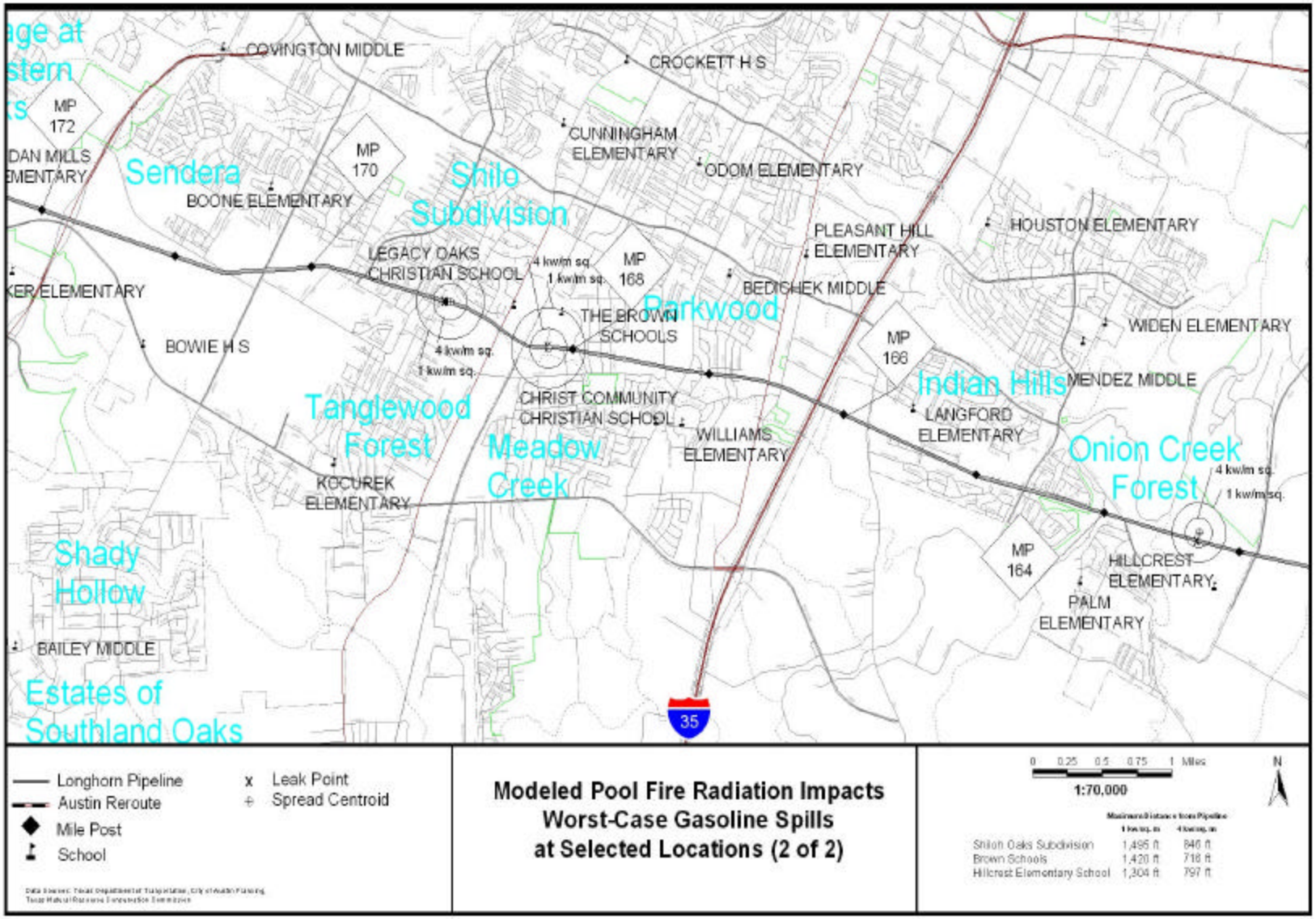
[1] *Evaluation of Dense Gas Simulation Models*, U.S. EPA 450/4-90-018, May 1991.
[2] *Guidelines for Use of Vapor Cloud Dispersion Models*, AICHE Center for Chemical Process Safety, 1987.
[3] *Hazardous Gas Model Evaluation with Field Observations*, "Atmospheric Environment", Hanna et al., 1993.


Austin Area Spill Scenarios
Travis, Hays Counties
Longhorn Pipeline
Austin Reroute
Mile Post
School
Leak Point
Spread Centroid
WCS Crude
WCS Gas
Cedar Valley Pump Station
MP 184
MP 183
MP 182
MP 181
MP 180
MP 179
1:40,000
Hillcrest 511 439
Nana's Daycare 888 584
Brown Schools 886 536
Shiloh Oaks 833 555
Sendera Oaks 712 619
CV Pump 727 631


COVINGTON MIDDLE
CROCKETT H S
MP 172
MP 170
MP 168
MP 166
MP 164
DAN MILLS EMENTARY
Sendera
BOONE ELEMENTARY
Shilo Subdivision
CUNNINGHAM ELEMENTARY
ODOM ELEMENTARY
PLEASANT HILL ELEMENTARY
HOUSTON ELEMENTARY
LEGACY OAKS CHRISTIAN SCHOOL
BEDICHEK MIDDLE
Parkwood
THE BROWN SCHOOLS
WIDEN ELEMENTARY
KER ELEMENTARY
BOWIE H S
Tanglewood Forest
CHRIST COMMUNITY CHRISTIAN SCHOOL
Indian Hills
MENDEZ MIDDLE
LANGFORD ELEMENTARY
WILLIAMS ELEMENTARY
Meadow Creek
Onion Creek Forest
KOCUREK ELEMENTARY
Shady Hollow
HILLCREST ELEMENTARY
PALM ELEMENTARY
BAILEY MIDDLE
Estates of Southland Oaks
35
Longhorn Pipeline
Austin Reroute
Mile Post
School
Leak Point
Spread Centroid
WCS Crude
WCS Gas
Austin Area Spill Scenarios
Travis County
0 0.25 0.5 0.75 1 Miles
1:70,000
N
Hillcrest 511 439
Nana's Daycare 668 584
Brown Schools 686 598
Shiloh Oaks 633 555
Sendera Oaks 712 619
CV Pump 727 631



Modeled Pool Fire Radiation Impacts
Worst-Case Gasoline Spills
at Selected Locations (1 of 2)


COVINGTON MIDDLE
CROCKETT H S
MP 172
MP 170
MP 168
MP 166
MP 164
CUNNINGHAM ELEMENTARY
ODOM ELEMENTARY
Sendera
BOONE ELEMENTARY
Shilo Subdivision
LEGACY OAKS CHRISTIAN SCHOOL
4 kw/m sq.
1 kw/m sq.
PLEASANT HILL ELEMENTARY
HOUSTON ELEMENTARY
BEDICHEK MIDDLE
Parkwood
THE BROWN SCHOOLS
BOWIE H S
WIDEN ELEMENTARY
Indian Hills
MENDEZ MIDDLE
LANGFORD ELEMENTARY
CHRIST COMMUNITY CHRISTIAN SCHOOL
WILLIAMS ELEMENTARY
Tanglewood Forest
Meadow Creek
Onion Creek Forest
KOCUREK ELEMENTARY
HILLCREST ELEMENTARY
PALM ELEMENTARY
Shady Hollow
BAILEY MIDDLE
Estates of Southland Oaks
35
Longhorn Pipeline
Austin Reroute
Mile Post
School
Leak Point
Spread Centroid
Modeled Pool Fire Radiation Impacts
Worst-Case Gasoline Spills
at Selected Locations (2 of 2)
0 0.25 0.5 0.75 1 Miles
1:70,000
N
Maximum Distance from Pipeline
1 kw/sq. m
4 kw/sq. m
Shiloh Oaks Subdivision 1,495 ft 846 ft
Brown Schools 1,420 ft 716 ft
Hillcrest Elementary School 1,304 ft 797 ft