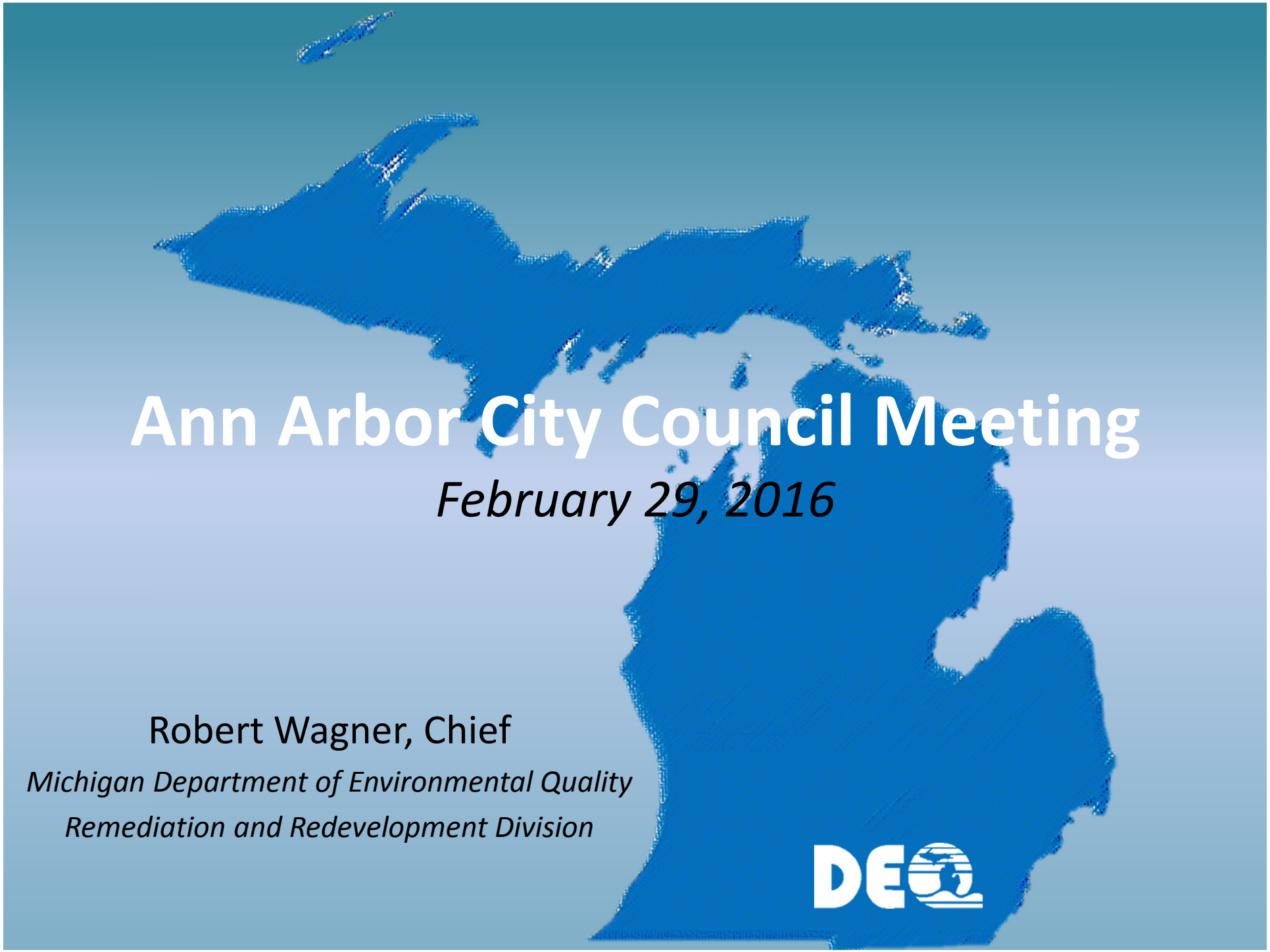


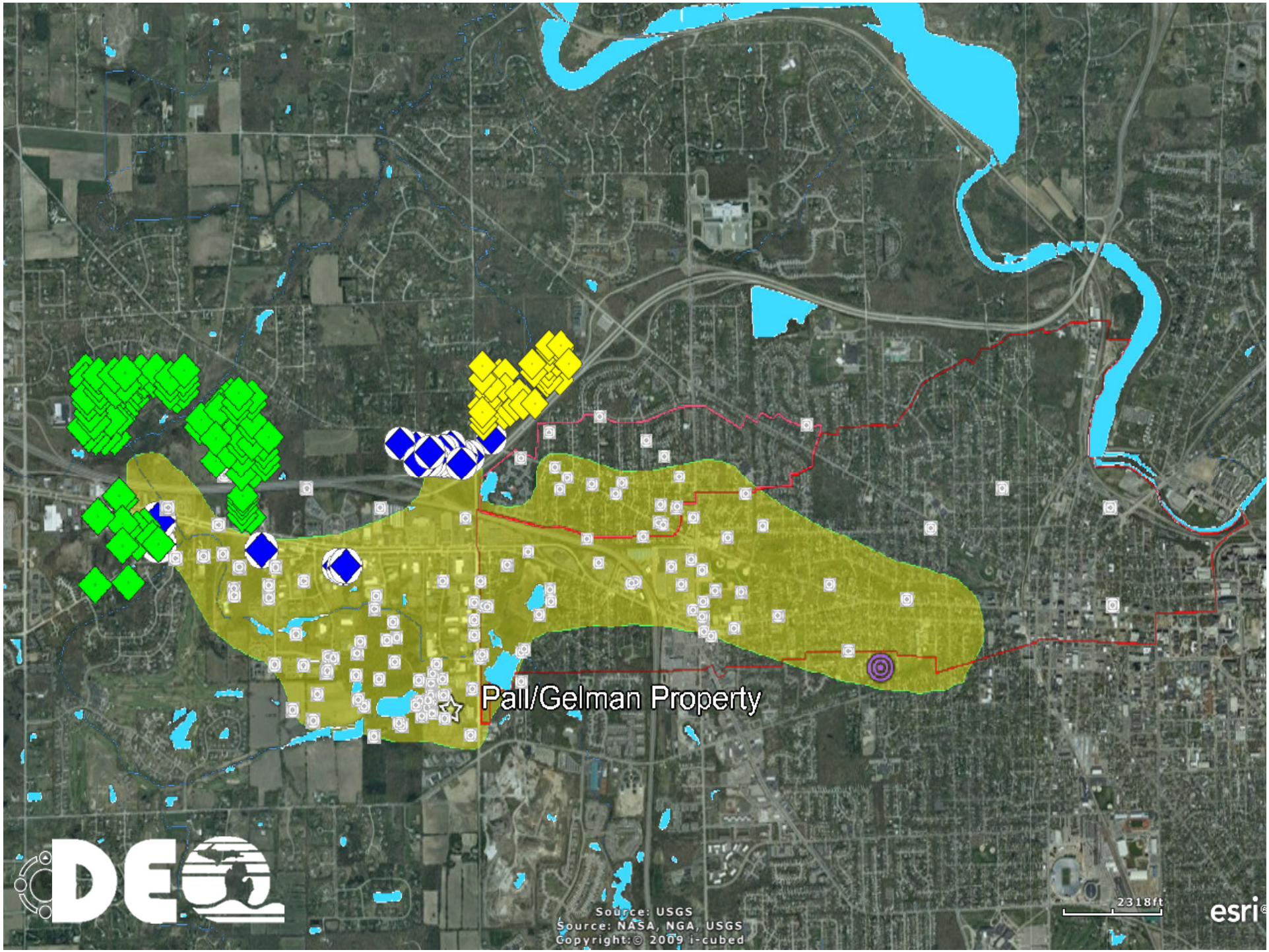
Ann Arbor City Council Meeting

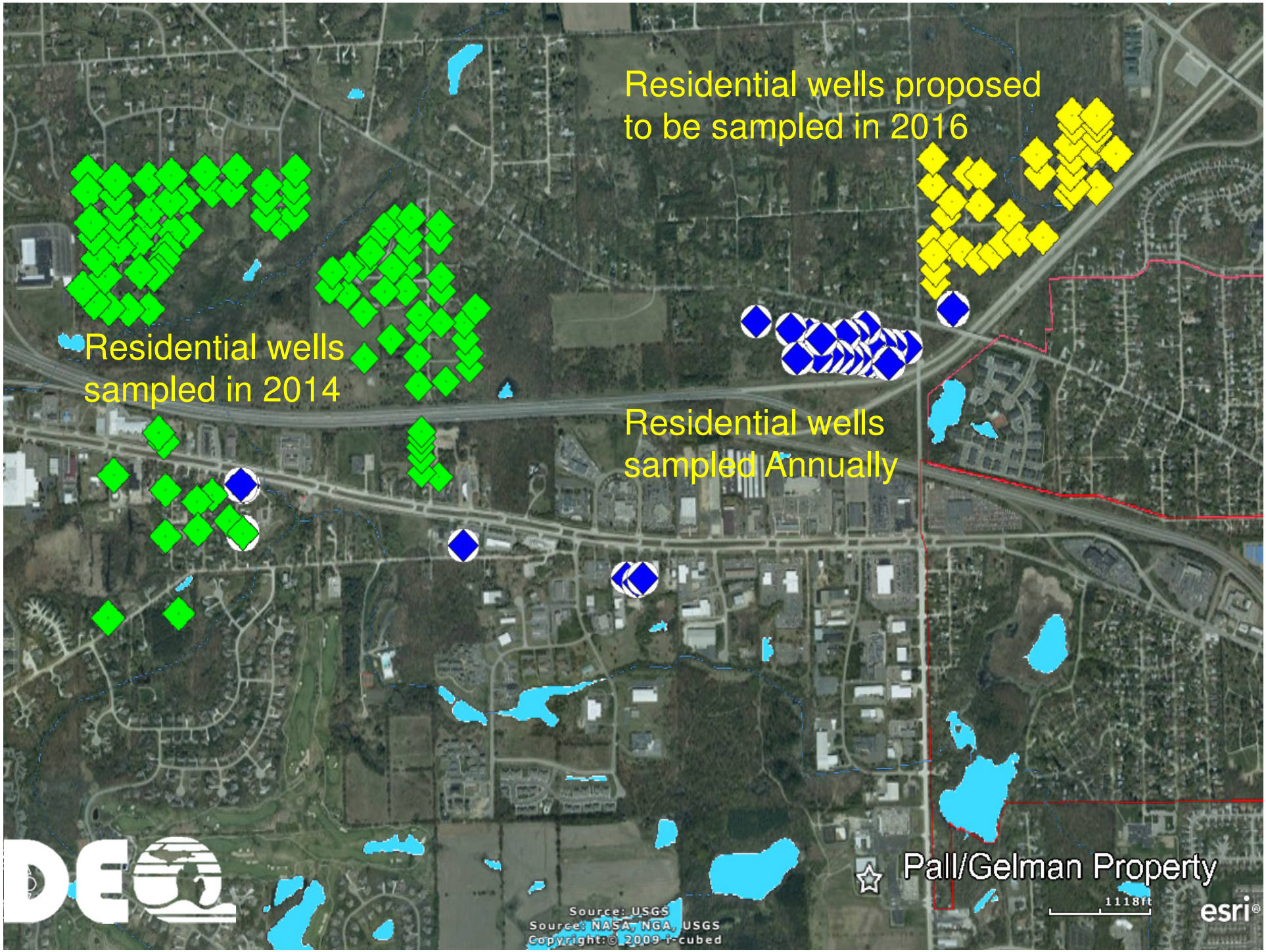
February 29, 2016

Robert Wagner, Chief

Michigan Department of Environmental Quality

Remediation and Redevelopment Division


Pall/Gelman Property
Source: USGS
Source: NASA, NGA, USGS
Copyright:© 2009 i-cubed
2318ft
esri


Residential wells proposed to be sampled in 2016
Residential wells sampled in 2014
Residential wells sampled Annually
Pall/Gelman Property
1118ft
Source: USGS
Source: NASA, NGA, USGS
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Rule 10 **Generic cleanup criteria for groundwater in aquifer used for drinking water** effective December 30, 2014 (Under Revision)

1. EQUATION FOR CARCINOGENIC EFFECTS:

$$DWV_{ca} = \frac{TR \times AT_{ca} \times CF}{SF \times EF_{res} \times IF_{dw}}$$

where,

DWV_{ca}	**(Drinking water value)**	=	**chemical-specific, µg/L or ppb**
TR	**(Target risk level)**	=	**10^{-5}**
AT_{ca}	**(Averaging time)**	=	**28,470 days**
CF	**(Conversion factor)**	=	**1,000 µg/mg**
SF	**(Oral cancer slope factor)**	=	**chemical-specific, $(mg/kg\text{-}day)^{-1}$**
EF_{res}	**(Exposure frequency)**	=	**350 days/year**
IF_{dw}	**(Age-adjusted drinking water ingestion factor)**	=	**1.1 L-year/kg-day**

6. **IF_{dw} for carcinogens (Equation 1) and noncarcinogens (Equation 3):**

$$IF_{dw} = \left(\frac{IR_{dw,age<1-6} \times ED_{age<1-6}}{BW_{age<1-6}}\right) + \left(\frac{IR_{dw,adult} \times ED_{adult}}{BW_{adult}}\right)$$

where,

IF_{dw}	**(Age-adjusted drinking water ingestion factor)**	=	**1.1 L-year/kg-day**
$IR_{dw,age<1-6}$	**(Drinking water ingestion rate, child)**	=	**0.78 L/day**
$ED_{age<1-6}$	**(Exposure duration, child)**	=	**6 years**
$BW_{age<1-6}$	**(Body weight, child)**	=	**15 kg**
$IR_{dw,adult}$	**(Drinking water ingestion rate, adult)**	=	**2.5 L/day**
ED_{adult}	**(Exposure duration, adult)**	=	**26 years**
BW_{adult}	**(Body weight, adult)**	=	**80 kg**

EPA
United States
Environmental Protection
Agency

Technical Fact Sheet – 1,4-Dioxane

January 2014

At a Glance

- Flammable liquid and a fire hazard. Potentially explosive if exposed to light or air.
- Found at many federal facilities because of its widespread use as a stabilizer in certain chlorinated solvents, paint strippers, greases and waxes.
- Short-lived in the atmosphere, may leach readily from soil to groundwater, migrates rapidly in groundwater and is relatively resistant to biodegradation in the subsurface.
- Classified by the EPA as "likely to be carcinogenic to humans" by all routes of exposure.
- Short-term exposure may cause eye, nose and throat irritation; long-term exposure may cause kidney and liver damage.
- No federal maximum contaminant level (MCL) has been established for 1,4-dioxane in drinking water.
- Federal screening levels, state health-based drinking water guidance values and federal occupational exposure limits have been established.
- Modifications to existing sample preparation procedures may be required to achieve the increased sensitivity needed for detection of 1,4-dioxane.
- Common treatment technologies include advanced oxidation processes and bioremediation.

Introduction

This fact sheet, developed by the U.S. Environmental Protection Agency (EPA) Federal Facilities Restoration and Reuse Office (FFRRO), provides a summary of the contaminant 1,4-dioxane, including physical and chemical properties; environmental and health impacts; existing federal and state guidelines; detection and treatment methods; and additional sources of information. This fact sheet is intended for use by site managers who may address 1,4-dioxane at cleanup sites or in drinking water supplies and for those in a position to consider whether 1,4-dioxane should be added to the analytical suite for site investigations.

1,4-Dioxane is a likely human carcinogen and has been found in groundwater at sites throughout the United States. The physical and chemical properties and behavior of 1,4-dioxane create challenges for its characterization and treatment. It is highly mobile and has not been shown to readily biodegrade in the environment.

What is 1,4-dioxane?

- 1,4-Dioxane is a synthetic industrial chemical that is completely miscible in water (EPA 2006).
- Synonyms include dioxane, dioxan, p-dioxane, diethylene dioxide, diethylene oxide, diethylene ether and glycol ethylene ether (EPA 2006; Mohr 2001).
- 1,4-Dioxane is unstable at elevated temperatures and pressures and may form explosive mixtures with prolonged exposure to light or air (DHHS 2011; HSDB 2011).
- 1,4-Dioxane is a likely contaminant at many sites contaminated with certain chlorinated solvents (particularly 1,1,1-trichloroethane [TCA]) because of its widespread use as a stabilizer for chlorinated solvents (EPA 2013a; Mohr 2001)
- It is used as: a stabilizer for chlorinated solvents such as TCA; a solvent for impregnating cellulose acetate membrane filters; a wetting and dispersing agent in textile processes; and a laboratory cryoscopic solvent for molecular mass determinations (ATSDR 2012; DHHS 2011; EPA 2006).
- It is used in many products, including paint strippers, dyes, greases, varnishes and waxes. 1,4-Dioxane is also found as an impurity in antifreeze and aircraft deicing fluids and in some consumer products (deodorants, shampoos and cosmetics) (ATSDR 2012; EPA 2006; Mohr 2001).

Are there any federal and state guidelines and health standards for 1,4-dioxane? (continued)

- Federal and State Standards and Guidelines (continued):
  - The EPA has established drinking water health advisories for 1,4-dioxane, which are drinking water-specific risk level concentrations for cancer (10^{-4} cancer risk) and concentrations of drinking water contaminants at which noncancer adverse health effects are not anticipated to occur over specific exposure durations. The EPA established a 1-day health advisory of 4.0 milligrams per liter (mg/L) and a 10-day health advisory of 0.4 mg/L for 1,4-dioxane in drinking water for a 10-kilogram child. EPA also established a lifetime health advisory of 0.2 mg/L for 1,4-dioxane in drinking water (EPA 2012).
  - The EPA's drinking water equivalent level for 1,4-dioxane is 1 mg/L (EPA 2012).
  - EPA has calculated a screening level of 0.67 µg/L for 1,4-dioxane in tap water, based on a 1 in 10^{-6} lifetime excess cancer risk (EPA 2013c). [1, 2]
  - EPA has calculated a residential soil screening level (SSL) of 4.9 milligrams per kilogram (mg/kg) and an industrial SSL of 17 mg/kg. The soil-to-groundwater risk-based SSL is 1.4 x10^{-4} mg/kg (EPA 2013c).
  - EPA has also calculated a residential air screening level of 0.49 micrograms per cubic meter (µg/m^3) and an industrial air screening level of 2.5 µg/m^3 (EPA 2013c).
- Workplace Exposure Limits:
  - The Occupational Safety and Health Administration set a general industry permissible exposure limit of 360 mg/m^3 or 100 ppm based on a time-weighted average (TWA) over an 8-hour workday for airborne exposure to 1,4-dioxane (OSHA 2013).
  - The ACGIH set a threshold limit value of 72 mg/m^3 or 20 ppm based on a TWA over an 8-hour workday for airborne exposure to 1,4-dioxane (ACGIH 2011).
  - The NIOSH has set a ceiling recommended exposure limit of 3.6 mg/m^3 or 1 ppm based on a 30-minute airborne exposure to 1,4-dioxane (NIOSH 2010).
  - NIOSH also has established an immediately dangerous to life or health concentration of 500 ppm for 1,4-dioxane (NIOSH 2010).
- Other State and Federal Standards and Guidelines:
  - Various states have established drinking water and groundwater guidelines, including the following:
    - Colorado has established an interim groundwater quality cleanup standard of 0.35 µg/L (CDPHE 2012);
    - California has established a notification level of 1 µg/L for drinking water (CDPH 2011);
    - New Hampshire has established a reporting limit of 0.25 µg/L for all public water supplies (NH DES 2011); and
    - Massachusetts has established a drinking water guideline level of 0.3 µg/L (Mass DEP 2012).
  - The Food and Drug Administration set 10 mg/kg as the limit for 1-4-dioxane in glycerides and polyglycerides for use in products such as dietary supplements. FDA also surveys raw material and products contaminated with 1,4-dioxane (FDA 2006).
  - 1,4-Dioxane is listed as a hazardous air pollutant under the Clean Air Act (CAA) (CAA 1990).
  - A reportable quantity of 100 pounds has been established under the Comprehensive Environmental Response, Compensation, and Liability Act (EPA 2011).

[1] Screening Levels are developed using risk assessment guidance from the EPA Superfund program. These risk-based concentrations are derived from standardized equations combining exposure information assumptions with EPA toxicity data. These calculated screening levels are generic and not enforceable cleanup standards but provide a useful gauge of relative toxicity.

[2] Tap water screening levels differ from the IRIS drinking water concentrations because the tap water screening levels account for dermal, inhalation and ingestion exposure routes; age-adjust the intake rates for children and adults based on body weight; and time-adjust for exposure duration or days per year. The IRIS drinking water concentrations consider only the ingestion route, account only for adult-intake rates and do not time-adjust for exposure duration or days per year.