ABSTRAK

PEMETAAN DAN IDENTIFIKASI KEBERADAAN UTILITAS BAWAH PERMUKAAN DALAM PERENCANAAN PELEBARAN JALAN "X", KOTA BATAM, KEPULAUAN RIAU BERDASARKAN PERSPEKTIF *GROUND PENETRATING RADAR* (GPR)

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Pertumbuhan pembangunan dan kebutuhan infrastruktur jalan di Kota Batam menuntut pemetaan utilitas bawah permukaan yang akurat dan tepat. Posisi dan kedalaman jaringan utilitas (pipa air, pipa gas, kabel listrik, dll) sering kali belum diketahui. Penelitian ini bertujuan memetakan dan mengidentifikasi keberadaan utilitas bawah permukaan sepanjang trase pelebaran Jalan "X" di Batam dengan menggunakan metode *Ground Penetrating Radar* (GPR) frekuensi 900 MHz. Data GPR diperoleh dari 22 lintasan yang membentang sejauh 1,2 km, kemudian diolah menjadi potongan radargram 2D menggunakan perangkat lunak *ReflexW*. Selanjutnya, korelasi lintasan dan pemodelan 3D utilitas dilakukan dengan perangkat lunak *SketchUp Pro 2021*.

Hasil pengolahan menunjukkan empat jenis utilitas terdeteksi: pipa air (logam), pipa gas (logam), kabel listrik, dan pipa tak dikenal (logam). Pipa air terletak di sisi refle jalan dengan kedalaman rata-rata 1,2–1,9 m dari permukaan. Pipa gas ditemukan di sisi utara daerah penelitian (memotong jalan) pada kedalaman rata-rata 0,8–1,9 m. Kabel listrik terdeteksi di area tengah batas jalan dan sisi timur dengan kedalaman rata-rata 0,3–0,4 m. Pipa tak dikenal tersebar di sisi barat jalan dan ujung lintasan timur (area permukiman) pada kedalaman rata-rata 0,6–1,1 m. Korelasi semua lintasan radargram dan model 3D menunjukkan bahwa pipa air, kabel, dan pipa tak dikenal sejajar dengan jalan di pinggirnya, sedangkan pipa gas melintang menyeberang jalan.

Penelitian ini menunjukkan bahwa metode GPR efektif dalam memetakan utilitas bawah tanah. Informasi posisi, kedalaman, dan pola persebaran utilitas yang diperoleh dapat digunakan untuk mendukung perencanaan pelebaran jalan yang lebih aman dan efisien, mengurangi risiko kerusakan utilitas selama konstruksi.

Kata kunci: Utilitas bawah permukaan, *Ground Penetrating Radar* (GPR), radargram, pemodelan 3D, pelebaran jalan.

ABSTRACT

MAPPING AND IDENTIFICATION OF UNDERGROUND UTILITY PRESENCE IN THE PLANNING OF ROAD WIDENING "X", BATAM CITY, RIAU ISLANDS BASED ON GROUND PENETRATING RADAR (GPR) PERSPECTIVE

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The growth of development and increasing demand for road infrastructure in Batam City necessitate accurate and precise subsurface utility mapping. The position and depth of utility networks (such as water pipes, gas pipelines, electrical cables, etc.) are often unknown. This study aims to map and identify subsurface utilities along the widening route of "X" Road in Batam using the Ground Penetrating Radar (GPR) method with a frequency of 900 MHz. GPR data were collected from 22 survey lines spanning a total length of 1.2 km and processed into 2D radargram cross-sections using ReflexW software. Subsequently, line correlation and 3D utility modeling were carried out using SketchUp Pro 2021.

The processing results identified four types of utilities: water pipes (metal), gas pipelines (metal), electrical cables, and unidentified metal pipes. Water pipes were located on the eastern side of the road at an average depth of 1.2–1.9 meters from the surface. Gas pipelines were found on the northern side of the study area (crossing the road) at an average depth of 0.8–1.9 meters. Electrical cables were detected in the central part of the road boundary and the eastern side, at an average depth of 0.3–0.4 meters. Unidentified pipes were distributed on the western side of the road and at the eastern end of the survey line (residential area), at an average depth of 0.6–1.1 meters. Correlation of all radargram lines and the 3D model showed that the water pipes, cables, and unidentified pipes run parallel along the roadside, while the gas pipeline crosses the road.

This study demonstrates that the GPR method is effective in mapping underground utilities. The information on utility location, depth, and distribution patterns obtained from this study can support safer and more efficient road widening planning, reducing the risk of utility damage during construction.

Keywords**:** *Underground utilities, Ground Penetrating Radar (GPR), radargram, 3D modeling, road widening*.