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THE USE OF REMOTE SENSING IN REAL PROPERTY TRANSACTIONS AND CONSTRUCTION

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Remote sensing has the potential to be hugely beneficial to real property transactions and construction. The information it collects through imagery and other instruments can show what areas of land are susceptible to dangerous conditions. If this information is gathered and provided to developers or would-be property owners, this could prevent the destruction of homes and other structures in areas would otherwise have been thought to be safe. Gathering information via remote sensing should be a requirement prior to development for this reason.

I. INTRODUCTION TO REMOTE SENSING

Remote sensing, in the simplest words, means obtaining information about an object without being in touch with it – thus in contrast to on-site observation.[1] Remote sensing consists of collect-

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[1] The United States House of Representatives Committee on Science and Astronautics additionally defined remote sensing as "the acquisition of information about specific objects or phenomena in which the information gathering device is not in intimate contact with the subject under investigation." GEORGE J. ZISSIS, *The Development of Remote-Sensing of Earth Resources, in* REMOTE SENSING OF EARTH RESOURCES 119, 120 (1972). *See also* the UNITED NATIONS COMMITTEE ON PERMANENT USES IN OUTER SPACE, DRAFT REPORT OF THE WORKING GROUP ON REMOTE SENSING OF THE EARTH BY SATELLITES ON THE WORK OF ITS SECOND SESSION, U.N. COPUOS, U.N. Doc. A/AC. 105/C.1/WG.4/L.4 at 2 (1973), stating that

> [R]emote-sensing of the earth from outer space is defined as a methodology to assist in characterizing the nature and/or condition of features

ing data from objects, materials, and situations on the Earth by means of sensors mounted onto crafts at sea, in the air, and in space, and then processing the data for quantification, qualification, and mapping purposes.[2] Remote sensing can be used to look at soil composition and determine a location's susceptibility to natural disasters.

Remote sensing is used in numerous fields, including geography, land surveying, and most Earth science disciplines such as hydrology, oceanography, glaciology, and geology. It also raises many interesting and complex questions regarding privacy and the rights to captured information, such as whether a person may be compensated for information remotely taken from his or her property without permission or knowledge. All of these are fascinating topics; however, for the purposes of this article, I will focus on the use of remote sensing real property in real estate transactions and development..

A. The Origins and Evolution of Remote Sensing

In its most basic form, remote sensing of the land is not something new. Prior to civilian use, satellites were used by the military and intelligence forces of the major world powers.[3] The technology quickly moved into non-military applications.

The first remote measurements of the earth by satellite for civilian purposes were made by the meteorological satellite, Television Infrared Observation Satellite (TIROS-1), which was launched by NASA on April 1, 1960.[4] Then, in 1972, when the

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> or phenomena on, above or below the earth's surface by means of observation and measurements from space platform … at present, such methods depend upon the emission and reflection of electromagnetic radiations.

[2] Patrick A. Salin, *Proprietary Aspects of Commercial Remote-Sensing Imagery*, 13 NW. J. INT'L L. & BUS. 349, 352 (1992) (citing Sikke A. Hempenius, Inaugural speech at the Agricultural University of Wageningen, Netherlands (March 1978)).

[3] Captain Michael R. Hoversten, *U.S. National Security and Government Regulation of Commercial Remote Sensing from Outer Space*, 50 A.F. L. REV. 253, 253 (2001).

[4] *TIROS*, NAT'L AERONAUTICS AND SPACE ADMIN. (May 22, 2016), https://science.nasa.gov/missions/tiros.

United States launched its Earth Resources Technology Satellite (ERTS-1)[5] (later renamed LANDSAT 1), remotely sensed imagery became commercialized.[6] After the launch of ERTS-1, other countries began launching their own satellites and the availability of remotely sensed imagery became more widely accessible.[7]

Later, NASA would sell data from LANDSAT to other States through bilateral contracts.[8] These contracts enabled these countries to establish ground stations in their own territory.[9] The data from LANDSAT was then transmitted to receiving stations on the ground.[10] In exchange for access to LANDSAT data, station operators of participating countries paid a large annual access fee and a distribution fee on each data product sold.[11]

In 1992, U.S. Congress passed Section 5621 of the Land Remote-Sensing Policy Act, which authorized the Secretary of Commerce to issue licenses for private space-based remote-sensing systems.[12] The Act defines land remote sensing as the collection of data which can be processed into imagery of surface features on the Earth from a satellite.[13] Private companies then began selling the high-resolution images of the Earth and its resources.[14] In March 1994, the Clinton administration passed a policy allowing

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[5] Hoversten, *supra* note 3. *See also* JOHN H. BOEKEL, NAT'L AERONAUTICS AND SPACE ADMIN., ERTS-1 SYSTEM PERFORMANCE OVERVIEW 2 (1974), https://ntrs.nasa.gov/api/citations/19740022593/downloads/19740022593.pdf.

[6] Hoversten, *supra* note 3, at 254.

[7] *Id.* at 253-254.

[8] Patrick A. Salin, *LANDSAT Contracts Signed by US Agencies with Foreign Ground-Stations: Commercial Remote-Sensing from NASA Scientific Experiments to EOSAT Private Endeavours*, 41 ZLW 165, 165-167 (1992) [hereinafter *LANDSAT Contracts*]. *See also Fifteen Years of Open Data Allows Advancements in Landsat Use and Research*, NAT'L AERONAUTICS AND SPACE ADMIN. (Apr. 21, 2023), https://landsat.gsfc.nasa.gov/article/fifteen-years-of-open-data-allows-advancements-in-landsat-use-and-research/.

[9] Salin, *LANDSAT Contracts*, *supra* note 8, at 167.

[10] *Id.*

[11] *Id. See generally* International Cooperation and Competition in Space, Hearing Before the Subcommittee on Space Science and Applications of the Committee on Science and Technology, 98th Cong., 2d Sess. 126 (1984).

[12] 15 U.S.C. § 5621 (1992).

[13] 15 U.S.C. § 5602 (1992).

[14] Hoversten, *supra* note 3, at 254.

the private sale of images obtained from remote-sensing systems.[15]

The result of this policy was that American companies were free to exchange and sell remotely sensed images in the international market, regardless of whether that information had been obtained from satellite, crewed aircraft, or uncrewed aircraft.[16] In the current day, remotely-sensed imagery can easily be available to developers, insurance companies, and others with an interest in real estate.

B. Components of a Remote-Sensing System

The primary components of a remote-sensing payload system include a laser, scanner, high resolution digital still camera(s), and video camera(s).[17] These components work together to produce photogrammetric images, which are obtained through photogrammetry, the process of capturing the physical dimension of objects on or above the surface of the Earth from measurements on aerial photographs of the objects. Images of an object or a scene of objects are taken from different angles, allowing data such as measurements, distances, and surface properties to be extracted.[18] The end product is a 3D model of the objects measured.

These photogrammetric images provide the qualitative and quantitative characteristics of the objects recorded.[19] Qualitative characteristics are those such as shape, pattern, tone, and texture (for example, identifying deciduous versus coniferous trees, delineation of geologic landforms, and inventories of existing land),

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[15] WHITE HOUSE, PRESIDENTIAL DECISION DIRECTIVE/NSC-23: U.S. POLICY ON FOREIGN ACCESS TO REMOTE SENSING SPACE CAPABILITIES 6 (1994), https://clinton.presidentiallibraries.us/items/show/12747.

[16] *Id.* at 2. "The fundamental goal of the policy is to support and to enhance US industrial competitiveness in the field of remote-sensing…[w]hile at the same time protecting US national security and foreign policy interests."

[17] *See generally* Mojtaba Abolghasemi & Dariush Abbasi-Moghadam, *Design and Performance Evaluation of the Imaging Payload for a Remote Sensing Satellite*, 44 OPTICS & LASER TECH. 2418, 2418 (2012).

[18] UNIV. OF ARIZONA, PRINCIPLES OF PHOTOGRAMMETRY (1993), 1 https://lpl.arizona.edu/hamilton/sites/lpl.arizona.edu.hamilton/files/courses/ptys551/Principles_of_Photogrammetry.pdf.

[19] *Id.*

while quantitative measurements can include rock height, tree height, stockpile volumes, and the coordinates of unknown points.[20] The quantitative characteristics of objects such as size, orientation, and position are determined from measured image positions in the image plane of the camera taking the photograph.[21]

Sensing techniques may be passive or active.[22] In a passive system, the remote sensing instrument simply receives whatever radiation happens to arrive and selects the radiation of the particular wavelength range that it requires.[23] In an active system, the remote sensing instrument itself generates radiation, transmits that radiation toward a target, receives the reflected radiation from the target, and extracts information from the return signal.[24]

"LIDAR," which stands for Light Detection and Ranging, is an active remote sensing method that uses light in the form of a pulsed laser to measure distances between objects.[25] A LIDAR instrument principally consists of a laser, a scanner, and a specialized GPS receiver.[26] These light pulses – combined with other data recorded by the airborne system – generate precise, three-dimensional information about the shape of the Earth and its surface characteristics.[27] LIDAR systems are used to examine both natural and manmade environments with accuracy, precision, and flexibility.

Additionally, there are two subcategories of LIDAR, topographic and bathymetric, each of which performs different functions. Topographic LIDAR uses a near-infrared laser to map the

[20] *Id.*
[21] *Id.*
[22] *Passive vs Active Sensors in Remote Sensing*, GIS GEOGRAPHY, https://gisgeography.com/passive-active-sensors-remote-sensing/#:~:text=Types%20of%20Remote%20Sensing&text=Active%20sensors%20have%20their%20own,passive%20sensors%20measure%20this%20energy (last updated May 30, 2022).
[23] *Id.*
[24] *Id.*
[25] *What Is Lidar?*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., https://oceanservice.noaa.gov/facts/lidar.html (last updated Jan. 20, 2023).
[26] *Id.*
[27] *Id.*

land and objects on the land, while bathymetric LIDAR uses a water-penetrating green light to measure the "beds" or "floors" of water bodies, including the ocean, rivers, streams, and lakes.[28]

There are several combined topographic and bathymetric LIDAR systems that have been used extensively to map shoreline and nearshore areas. Combined topographic-bathymetric LIDAR data sets, such as those collected by the Joint Airborne LIDAR Bathymetry Technical Center of Expertise (JALBTCX),[29] provide the elevation data required to produce datum-based shorelines.[30] The gathered data can be used to show how high water levels may rise, giving developers a better idea of the risks of building in a particular area.

Platforms used in remote sensing include satellites, manned aircraft, and unmanned aircraft systems (UAS).[31] Airplanes and

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[28] *Id. See also* NAT'L OCEANIC AND ATMOSPHERIC ADMIN., LIDAR 101: AN INTRODUCTION TO LIDAR TECHNOLOGY, DATA, AND APPLICATIONS 35 (2012), https://coast.noaa.gov/data/digitalcoast/pdf/lidar-101.pdf [hereinafter NOAA, LIDAR 101].

[29] *Joint Airborne Lidar Bathymetry Technical Center of Expertise*, US ARMY CORPS OF ENGINEERS, https://www.sam.usace.army.mil/Missions/Spatial-Data-Branch/JALBTCX/ (last visited July 9, 2023).

> The mission of the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) is to perform operations, research, and development in airborne lidar bathymetry and complementary technologies to support the coastal mapping and charting requirements of the U.S. Army Corps of Engineers, the U.S. Naval Meteorology and Oceanography Command, and the National Oceanic and Atmospheric Administration (NOAA). JALBTCX staff includes engineers, scientists, hydrographers, and technicians from the Army Corps of Engineers Mobile District, the Naval Oceanographic Office (NAVOCEANO), the Corps Engineer Research and Development Center (ERDC), and the NOAA National Geodetic Survey (GDS). *Id.*

[30] NOAA, LIDAR 101, *supra* note 28, at 58.

[31] Unmanned aircraft: a device used or intended to be used for flight in the air that has no onboard pilot. This definition includes all classes of airplanes, helicopters, airships, and powered lift aircraft without an onboard pilot. *See* FED. AVIATION ADMIN., INTEGRATION OF CIVIL UNMANNED AIRCRAFT SYSTEMS (UAS) IN THE NATIONAL AIRSPACE SYSTEM (NAS) ROADMAP (2020), https://www.faa.gov/sites/faa.gov/files/uas/resources/policy_library/2019_UAS_

helicopters are the most commonly used platforms for acquiring LIDAR data over broad areas.[32] As laser scanners have become smaller, smaller aircraft are able to carry them.

C. Remote Sensing Using Unmanned Aircraft Systems (UAS)

While there are many benefits to using manned aircraft, the biggest downside, whether fixed wing or helicopter, is the cost, especially when compared to UAS.[33] The benefits of remote sensing via UAS include low material and operational costs, flexibility with the control of spatial and temporal resolution, high intensity data collection, and absence of risk to crew members.[34]

Flexible and inexpensive remote-sensing systems can help supplement existing remote-sensing capabilities and explore new applications. UAS as remote-sensing platforms increase the efficiency of data acquisition, and fill gaps and supplement the capabilities of manned aircraft and satellites. UAS are an increasingly popular platform for remote sensing. Their ability to fly at low altitudes helps in the acquisition of high-resolution images and information. Unmanned aircraft[35] are becoming large enough that they can carry heavier payloads and fly further.[36] Increasingly

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Civil_Integration_Roadmap_third_edition.pdf [hereinafter FAA UAS INTEGRATION ROADMAP].

[32] *What Is Lidar?*, *supra* note 25.

[33] *See Are UAS More Cost Effective Than Manned Flights?*, ASS'N FOR UNCREWED VEHICLE SYS. INT'L (Oct. 24, 2013), https://www.auvsi.org/are-uas-more-cost-effective-manned-flights.

[34] Aleksander Olejnik, Łukasz Kiszkowiak, Robert Rogólski, Grzegorz Chmaj, Michał Radomski, Maciej Majcher, & Łukasz Omen, *The Use of Unmanned Aerial Vehicles in Remote Sensing Systems*, 20 SENSORS (SPECIAL ISSUE: SELECTED PAPERS FROM THE 2019 IEEE INTERNATIONAL WORKSHOP ON METROLOGY FOR AEROSPACE) 1, 1 (2020).

[35] The FAA does not use the terms "unmanned aircraft system" and "unmanned aircraft" interchangeably. It uses the term "unmanned aircraft" when referring specifically to the unmanned aircraft itself and "unmanned aircraft system" when referring to both the unmanned aircraft and any communication links and components that control the unmanned aircraft. *See* 14 C.F.R. 1.1.

[36] Unmanned aircraft operations have significantly increased in number, technological complexity, and sophistication during recent years without specific regulations to address the unique characteristics, though existing rules have not been

smaller, lighter, and cheaper sensors have become available for drone remote-sensing applications.

Traditionally, remote sensing could only be done with satellites or manned aircraft.[37] However, unmanned aircraft are now able to fly these missions at a much lower cost. Advances in technology are one reason for the decrease in price. UAS are cost effective when compared to manned aircraft because they do not have to carry the weight of a human, and they are much smaller than a traditional helicopter or fixed wing aircraft.[38]

UAS can carry a variety of sensing instruments, including visible light, near infrared, shortwave infrared, thermal infrared, radar, and LIDAR sensors.[39] UAS are able to perform unique remote sensing functions. Consider forest canopy height, which is a critical parameter of forest health, and which was traditionally estimated with analog photos and ground surveys. However, though LIDAR technologies have become a new means for estimating canopy height, and traditional photogrammetry has almost been abandoned in forestry,[40] small forest gaps, which reflect disturbance and affect forest diversity and productivity, cannot be measured accurately with satellite remote sensing.[41] Additionally, LIDAR imaging can be used to gather accurate information about forest composition, structures, volume, and growth.[42] This sug-

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fully tailored to the unique features of unmanned aircraft. *See* FAA UAS INTEGRATION ROADMAP, *supra* note 31.

[37] *History of Remote Sensing*, HUMBOLDT STATE UNIV., http://gsp.humboldt.edu/olm/Courses/GSP_216/online/lesson1/history.html (last visited July 9, 2023).

[38] The Bell 429 helicopter is a widely used helicopter with an hourly cost of approximately $1,860. *See BELL 429 Price and Operating Costs*, AIRCRAFT COST CALCULATOR, *https://www.aircraftcostcalculator.com/AircraftOperatingCosts/396/Bell+429* (last visited July 9, 2023). *See also* ASS'N FOR UNCREWED VEHICLE SYS. INT'L, *supra* note 33.

[39] P. KRISHNA RAO, SUSAN J. HOLMES, RALPH K. ANDERSON, JAY S. WINSTON, & PAUL E. LEHR, *Remote Sensing Instrumentation*, *in* WEATHER SATELLITES: SYS., DATA, AND ENV'T APPLICATIONS 105-106 (1990).

[40] Lina Tang & Guofan Shao, *Drone Remote Sensing for Forestry Research and Practices*, 26 J. FORESTRY RSCH. 791, 792 (2015).

[41] *Id.* at 793.

[42] *Id.* at 791.

gests that drone remote sensing is capable of acquiring very high-resolution images suitable for characterizing forest gaps as reliable indicators of biodiversity.[43] LIDAR imaging can get measurements of tree sizes and forest density, and it can track the changes to soil that are natural or human-made.[44] Vegetation can have a substantial impact on the movement of soil, and so the ability to track vegetation helps predict future changes in the soil.[45] This can help to better understand the long-term and short-term risks of building in a specific area.

II. Benefits of Remote Sensing

One of the major advantages of aerial remote sensing techniques is the creation of a permanent archive of baseline data. Then, as new information is gathered, it can be compared to the historic information, allowing future trends to be hypothesized. For instance, the current makeup of a hillside or riverbed could be compared to previous data and the differences can be measured. By knowing how much soil has moved in a particular period, one may hypothesize how much soil will move in the future. This will help developers determine if it is safe to build in a particular location.

Remote sensing real property will have a positive impact on a majority of Americans. It can benefit anyone who ever buys or sells a home. Additionally, it impacts people who are not homeowners because natural disasters do not spare rentals – every person interacts with real estate in some way. Remote sensing can be used as part of the construction process. The information obtained through these observations can help engineers, architects, insurers, and government entities make educated decisions about where to allow construction or where a developer would want to develop.

Information obtained through remote sensing could make everyone involved in the real estate transaction or construction more informed and protected. It could be used by insurers as part

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[43] *Id.*
[44] *Id.*
[45] *See* P. Zhou, O. Luukkanen, T. Tokola, & J. Nieminen, *Effect of Vegetation Cover on Soil Erosion in a Mountainous Watershed*, 75 CATENA 319 (2008).

of the underwriting process. Municipalities could require it as part of the permitting process. Banks could require it as part of the loan application process.

Considerations include rebuilding in an area that has already suffered damage from fire, flood, or earthquake. If consumers knew remote sensing was an option, they would likely happily pay money to know the likelihood of a potential disaster. For example, someone moving from the Midwest to a mountainous part of the country might not understand the risks associated with purchasing a home on a cliff or mountainside. Similarly, someone moving from a mountainous part of the country to the Gulf Coast might not understand the risks from flooding.

Information about the shorelines and changes in riverbed elevations can help predict the future movement of water.[46] It can also predict where the water levels will be during a flooding event.[47] Developers can then determine how safe it is to build a home in a specific area or the likelihood of a home suffering damage in a flood.

Valuable and detailed information can be gathered when remotely sensing soil.[48] The type of rock formation and makeup can be determined by the energy absorbed.[49] Different metals react differently, and so it can be determined what type of rock make up a particular soil.[50] The soil makeup will determine the absorption levels of water from snow, rain, and floods.[51] This information will indicate the soil's vulnerability to erosion, mudslides, earthquakes, sink holes, and other potentially catastrophic events.

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[46] Hafiz Suliman Munawar, Ahmed W.A. Hammad, & S. Travis Waller, *Remote Sensing Methods for Flood Prediction: A Review*, 22 SENSORS (SPECIAL ISSUE: REMOTE SENSING FOR INTEGRATED DISASTER RISK MANAGEMENT) 960, 968 (2022).

[47] *Id.*

[48] *See* Mehrez Zribi, Nicolas Baghdadi, & Michel Nolin, *Remote Sensing of Soil*, 2011 APPLIED & ENV'T SOIL SCI. (SPECIAL ISSUE) 1 (2011).

[49] A. Nathues, MAX PLANCK GESELLSCHAFT, METHODS FOR REMOTE SENSING OF SURFACE COMPOSITION 12 (2023), https://www.mps.mpg.de/phd/planetary-interiors-and-surfaces-2011-part-02.pdf.

[50] *Id.* at 16.

[51] *See generally* Darrell Norton, Issac Shainberg, Larry Cihacek, & J.H. Edwards, *Erosion and Soil Chemical Properties*, in SOIL QUALITY & SOIL EROSION 39 (1999).

Information can be used prior to the development of homes or commercial buildings. The information can be used when accessing the risk of *rebuilding* in a "high risk" area that has already been hit by a natural disaster. For example, in Montecito, California, homeowners are rebuilding their mansions after they were completely destroyed in a 2018 mudslide.[52] All parties involved in the rebuilding – homeowners, property insurers, bankers, and municipalities – should have the information available to know where the land was, where it is now, and where it will likely be in the coming years. That specific mudslide was caused after strong rains hit an area that had recently burned from a forest fire. Remote sensing can determine, with pin-point accuracy, the current state of the vegetation, where it is coming back, and where it is still very barren.

A. Municipalities Would Benefit from Remotely Sensing Property

When disaster strikes, municipalities must spring into action. Government entities would be wise to require remote sensing as part of the building/zoning/application process – especially for large projects. In an effort to make residents safe, municipalities get involved in the tiniest of details when it comes to the development of real property. They get involved to save lives. Building codes have saved countless lives.

In Buckeye, Arizona, a master planned community that will have a total buildout of more than 100,000 homes and 55 million square feet of commercial buildings is currently under construction.[53] Before a development such as this is approved, the land should be remotely sensed to look for any unknown flood zones, sink holes, or fault lines. Building permits should not be given until the developer can show that there are no unknown dangers beneath the land.

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[52] *Montecito Digs Out from Deadly Mudslides* (CBS Los Angeles television broadcast Jan. 9, 2018), https://youtu.be/5wsZi_-puH8?t=44.

[53] *100,000-Home Teravalis Breaks Ground in Buckeye*, AZBIGMEDIA (Dec. 18, 2022), https://azbigmedia.com/real-estate/massive-teravalis-master-planned-community-breaks-ground-in-buckeye.

B. Benefit to Insurance Companies and Lending Institutions

Insurance companies are the one group who could benefit more from remote sensing than any other on this list.[54] Their whole business is determining the risk that an area of real property will be damaged and if so, how much it will cost to repair it. Insurers should be excited at the opportunity to avoid problems before it is too late, particularly at such accuracy and cost-effectiveness.

Insurance companies are in the business of analyzing risk, quantifying the value of that risk, and then providing benefit to their clients. Insurers could benefit by requiring would-be clients to obtain coverage/policy or they could provide a discount for those who had sensed their property and could show that it was free from material defects.

Additionally, lending institutions would benefit from an enhanced understanding of the land where a home is or will be located. If a debtor or client's home is destroyed by a natural disaster, it is likely that they will not be making their monthly mortgage payments while things are being sorted out. Often, after a disaster, insurance companies are slow to settle with homeowners about what is and is not covered under their policy.

C. Remote Sensing Reduces Risk

The National Oceanic and Atmospheric Administration (NOAA) has developed flood mapping systems that use data and imagery from their multiple satellites and unmanned aircraft.[55] These maps are a way to measure the evolution and dynamics of flooding by providing high resolution detail over vast areas. NOAA's flood maps give first responders important information about

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[54] Steph Bednar, *Underwriting and Remote Sensing: Satellites to Selfies*, VERISK (Feb. 1, 2017), https://www.verisk.com/insurance/visualize/underwriting-and-remote-sensing-satellites-to-selfies/#:~:text=Remote%20sensing%20technology%20helps%20insurers,estimate%20damage%2C%20and%20much%20more.

[55] *See Sea Level Rise Viewer*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., https://coast.noaa.gov/slr/#/layer/slr/0/-11581024.663779823/5095888.569004184/4/satellite/none/0.8/2050/interHigh/midAccretion (last visited July 9, 2023).

the location and extent of the flooding, where to employ limited resources, and when it is safe for people to return to their homes.[56]

IV. SHOULD BE USED BUT NOT MANDATORY

When people understand the benefits of having their land remotely sensed, then they will know for certain they are building on solid ground. Though the benefits of remote sensing are wide reaching, remote sensing should not become mandatory because it is not necessary in every situation.

For example, using a title company is not mandatory when buying or selling real property; however, in the vast majority of transactions, a title company is used.[57] This is because the relatively small cost offsets the potential losses. It is reasonable to think that the same mindset would apply to the relatively small cost of remote sensing analysis over a property.

A. Compliance: Voluntary or Mandated? The Case for Mandatory Use of Remote Sensing

Most municipalities have very stringent permitting processes for new construction and get involved in very nuanced requirements to obtain the permits required.

For context, let us examine the processes required by local municipalities to build a new home in Phoenix, Arizona. This can give us a sense of some of the local requirements to build in an average American city. In Arizona, each time a parcel of land is bought or sold, a "Phase I" environmental inspection must be completed by a licensed company.[58] The purpose of this inspection is to look for any dangerous contaminants that may be present in the soil.[59] If dangerous contaminants are found, then additional inspections must occur, and the owner may be forced to clean the

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[56] *Id*.
[57] *Who Picks the Title Company, Buyer or Seller?*, SCOTT TITLE SERV., https://scottitle.com/who-picks-the-title-company-buyer-or-seller/ (last visited July 9, 2023).
[58] *Phase 1 Environmental Site Assessment*, GUTIERREZ-PALMENBERG, INC., https://gpieng.com/phase-i-esa/ (last visited July 9, 2023).
[59] *Id.*

site before any development can occur.[60] Once it is determined that a parcel is free of dangerous contaminants, the sale can move forward.

The potential new homeowner must verify that his or her would-be home conforms with zoning requirements for that specific parcel.[61] If it is not zoned for a single-family residential home, then a change in zoning must first be obtained.[62] Adjusting the zoning is often a multi-year process and includes hiring attorneys who specialize in re-zoning. Once the zoning is out of the way, then a site plan must be approved. The proposed site plan shows where the house will be situated, setbacks, easements, water wells, the septic tank, the pool, etc. Once the site plans are approved, then the blueprints can be submitted for approval and then the general contractor can begin hiring subcontractors and requesting permits for electricity, natural gas, and water.

The works permits are only good for a certain period of time and so if the work is not completed in that specific time, then a permit seeking additional time can be requested.[63] If, while an inspector is at a construction site performing inspections as required by a permit, and he or she sees that other, unpermitted work is evident at the construction site, he or she will withhold granting any permits until the unpermitted work has been approved.[64]

Many homes in Arizona use water wells to bring potable water to their homes.[65] The process of drilling a water well, installing water tanks, and the water pipes to bring water to the house is

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[60] *Id.*
[61] *Understanding Zoning and Land Use in Arizona*, MACQUEEN & GOTTLIEB, PLC (May 6, 2019), https://www.mandglawgroup.com/2019/05/06/understanding-zoning-and-land-use-in-arizona/.
[62] *Id.*
[63] *See Plan Review & Permits*, CITY OF PHOENIX, https://www.phoenix.gov/pdd/development/permits (last visited July 9, 2023).
[64] *See Residential Permit Customers*, CITY OF PHOENIX, https://apps-secure.phoenix.gov/PDD/Permits/Instructions/8 (last visited July 9, 2023).
[65] *Permitting and Wells Data Dashboard*, ARIZONA DEP'T OF WATER RES., https://new.azwater.gov/permitting-wells/wells-data (last accessed July 9, 2023).

complicated and nuanced.[66] Initially, a "notice of intent to drill" must be filed with the Arizona Department of Water (ADW).[67] An employee from the ADW will perform an on-site inspection and if all goes well, then the drilling can begin.[68] The drilling must be completed by a company that has special licenses and obtains the proper permit to begin drilling.[69] Once the well is drilled, then the water must be tested by the Arizona Department of Environmental Quality.

The above steps are just a few of the many, many steps required to build a new home or otherwise make improvements on property in a typical American city. What is the core justification for requiring so many permits, licenses, and inspections? Safety! With safety as a goal, then a parcel of land should be remotely sensed at least once before a new development can be constructed, particularly in in areas that have been deemed "high risk." This information can ensure that city inspectors and planners have an extra layer of information to review before approving construction permits.

VII. CONCLUSION

Remote sensing is a modern marvel that should be used to gather more information whenever possible. The accuracy, efficiency, and cost-effectiveness of remotely sensing real property should be embraced by all of those involved in the construction, finance, insurance, and ownership of real property. The information produced can save lives, reduce risk, and bring awareness to risks. It is something that companies, governments, and individuals should require moving forward.

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[66] *Well Drilling in Arizona,* ARIZONA DEP'T OF WATER RES., https://new.azwater.gov/permitting-wells/well-drilling-arizona.
[67] *Id.*
[68] *Id.*
[69] *Id.*