University of Maryland
Comments on the Purple Line Alternatives Analysis and
Draft Environmental Impact Statement
(AA/DEIS)
January 9, 2009

The Purple Line will benefit the University by providing enhanced access to educational and research resources for students and faculty and by enhancing access to the University for visitors including potential students, visiting faculty and research collaborators. Furthermore, it will assist in the development of the East Campus. For these reasons, the University supports the construction of the Purple Line.

The University of Maryland has reviewed the AA/DEIS. The report does not address the adverse impact that the Light Rail traffic will have on the University's research environment. The impact is known, measurable, and substantial. The Maryland Transit Authority must acknowledge the deleterious effects of electromagnetic interference and vibrations on sensitive research. The AA/DEIS must describe with particularity whether the MTA will eliminate or mitigate them to the level compatible with the University's long-term research mission and how it intends to do it and how it intends to maintain it over the life of the transit system.

Currently, the University enjoys the benefits of very "quiet" electromagnetic and vibration environments. It is compatible with the use of today's most sensitive instruments. These natural resources have enabled the University to successfully compete for cutting-edge science funding and rise as a national research powerhouse. The University presently attracts $400 million in annual grant and contract awards. This constitutes one-third of its educational funding. The environment that sustains this university mission must be guaranteed into the future.

In ordinary operation, mass transit, and Light Rail in particular, will generate changes in the local magnetic field of the Earth, producing electromagnetic interference (EMI). Light rail systems also produce ground vibrations, which, though not large enough to disturb people, can disturb sensitive instruments and precise observations and measurements. If not satisfactorily mitigated, EMI and vibration interferences from the Purple Line, singly and in combination, will create a "research dead zone" for sensitive measurements of up to many hundred feet on each side of the tracks through campus. The research dead zone of the proposed Campus Drive alignment spans the core of the University's existing laboratories and research facilities that use these highly sensitive instruments and includes potential future building sites.

The University hired nationally recognized consultants to measure our current research environment with respect to EMI and vibrations. They have conducted similar analyses at other national universities that are planning for transportation systems operating in their proximity. This is a known and common national issue which is being addressed by the University of Washington, Washington University at St. Louis, and the University of Colorado Medical Center, among others. The consultants made measurements along the proposed Purple Line alignments through campus. They have predicted the impact of Light Rail based on the equipment and operations consistent with that described in the AA/DEIS. Three reports have been prepared: *Survey of Ambient Magnetic Fields on the*

University of Maryland Campus (October 6, 2008), *Campus Vibration and Noise Ambient Environment* (October 14, 2008), and *Example Train Vibration Predictions* (December 9, 2008). MTA consultants were present during these studies. The data and these reports have been shared with them. Copies are included with these comments.

The conclusion, drawn from the data in these University studies and the specifications of existing research equipment, is that the transit of Light Rail trains through campus will prohibit the use of existing equipment that is sensitive to magnetic field fluctuations and/or vibrations within a "dead zone" on each side of the tracks because the levels of EMI and vibration generated will be greater than the tolerances of the equipment. There will be a dead zone, but its size depends in part on the type of train system and the mitigation techniques used and in part on the operation and maintenance of the Light Rail system into the future. The location of the dead zone depends on the alignment selected. All these issues are critical to any Light Rail system planned for use near buildings that house or will house equipment sensitive to ground vibration and EMI effects, especially with a permanent alignment.

Electromagnetic Interference

Fluctuations in Earth's magnetic field interfere with the operation of scientific instruments that utilize charged beams or high-precision magnet systems. These instruments include the basic tools of modern research such as electron microscopes, electron beam lithography systems, focused ion beams, and systems requiring a very stable magnetic field, such as magnetic field imaging devices and nuclear magnetic resonance (NMR) spectrometers. Virtually all of these instruments are in daily use on the campus.

Light Rail trains disturb Earth's magnetic field and thereby produce electromagnetic interference in two ways:

1) Electric currents generate magnetic fields. Light Rail trains use large currents that change in strength and location as the train accelerates or moves past a location. This results in large fluctuations in the magnetic field of Earth as the train passes nearby. This "propulsion" field can be partially mitigated by decreasing the current or decreasing the distance between the current feed and return lines via a modified catenary system design. It decreases with distance from the source.

2) The movement of a large mass of ferromagnetic material, i.e., steel, in the Light Rail vehicles, perturbs the magnetic field produced by Earth. The size of this 'perturbation' field depends on the amount of mass, how susceptible it is to being magnetized, and distance. This effect can be mitigated by using non-conducting materials for train cars. Like the propulsion field, the perturbation field decreases with distance from the source.

A common unit of measure for EMI is a milliGauss (mG). Modern electron beam microscopes and nuclear magnetic resonance instruments, according to manufacturer's specifications, are adversely affected by EMI above 0.1 mG. The sensitivity of future instruments will very likely increase and will certainly not decrease. Currently, ambient magnetic field fluctuations average about 0.15 mG at existing and planned research sites on the campus.

Based on EMI from Light Rail systems similar to the train configuration described in the AA/DEIS, University consultants have estimated that operation of the Light Rail Purple Line could result in EMI exceeding 0.2 mG as far away as 660 feet (200 m) from the tracks.

A map of the campus in Figure 1 (http://sp07.umd.edu/PurpleLineMap1.pdf) shows the potential total EMI impact including a ¼ mile wide research dead zone for modern electron beam instrument operation. This zone includes major science research buildings (H.J. Patterson Hall, Microbiology, Physics, Bioscience Research Building, Biology-Psychology, Plant Sciences, and Geology along the Campus Drive alignment, and Marie Mount Hall on the Preinkert alignment). It also shows potential building sites in the Facilities Master Plan that will be negatively impacted unless the impacts are mitigated.

Vibrations

Vibrations traveling through the soil and structures interfere with the operation of a large number of commonly used instruments including electron beam instrumentation, atomic force microscopes, scanning tunneling microscopes, electron-beam lithography systems, laser interferometers and gravity gradiometers.

The U.S. National Institute of Standards and Technology (NIST) and the Institute of Environmental Science and Technology (IEST) have determined and specified the "quiet vibration environment" required for successful use of such sensitive instruments. Together they describe the acceptable tolerances to vibration: the NIST-A standard and the IEST VC-G standard have been commonly used for high end research. These standards are used in industry and academia today to ensure that conditions are acceptable for operating sensitive research instrumentation. The demands of future standards are likely to increase as instruments become more sensitive and as fields such as quantum computations, biotechnology and nanotechnology continue to develop. Today, most university research buildings meet or are comparable to the NIST-A criterion. Where there are deviations from this standard, the vibration problems result primarily from internal mechanical equipment, which can be replaced, isolated or moved as the need arises. In the absence of these local sources, the campus environment would be comparable to NIST-A at low frequencies and VC-G at higher frequencies.

Light Rail trains produce time-varying forces on their rails that generate vibration in the soil. Ground vibrations will propagate to campus buildings, producing an unsatisfactory platform for sensitive instruments. The amount of force exerted by a train on the soil is a product of many factors, including the train's weight, speed, wheels, suspension system as well as the vibration isolation and condition of the track. Maintenance of the Light Rail cars, tracks and system are also critical to achieving a sufficiently quiet vibration environment over the long term. Although MTA has not specified the design or manufacture of the trains it intends to run, data from other Light Rail systems and the Federal Transit Authority's *Transit Noise and Vibration Impact Assessment* allow a reasonable estimate of the vibration produced by trains and track equipment of the general type depicted in the AA/DEIS. The distance the light rail system will produce an impact can then be estimated from recent studies of soil conditions and conductivity on campus.

A campus map showing the zone where Light Rail vibrations are likely to be in excess of the NIST-A standard is shown in Figure 2 (http://sp07.umd.edu/PurpleLineMap2.pdf), and the zone where Light Rail vibrations will be in excess of the VC-G standard is shown in Figure 3 (http://sp07.umd.edu/PurpleLineMap3.pdf). To draw this map the assumption was made that the Purple Line train will be 160 feet long and travel at 15 mph, as specified by the MTA, and that no mitigation is in place. The size of these dead zones will expand because of increasing vibrations as natural wear and tear to train wheels, rails, and roadbed occurs, and as maintenance is deferred. Also, the actual train selected could result in a higher train forcing function, which in turn would result in an expanded dead zone. Vibration violating NIST-A and VC-G will make current research buildings unsuitable for highly sensitive work. (Current buildings affected along the Campus Drive alignment include H.J. Patterson, Microbiology, Bioscience Research Building, Biology-Psychology, Plant Sciences, Physics, and Geology.) Locating future research buildings within the dead zone would be prohibited.

Acoustical Noise

For the most part, airborne noise is a human annoyance issue. However, some noise-sensitive research is currently conducted at the University. Unlike EMI and ground vibration, substantial engineering and research efforts have been dedicated to quantifying and evaluating the impact of noise on human activities. The University agrees that the FTA guidelines such as those described in the AA/DEIS provide a good starting point. However, the document does not make clear what FTA Land Use Category was used for the University. Much of the campus is dedicated to Category 3 uses, i.e., institutional land uses with primarily daytime and evening use. However, significant portions could be considered Category 2 uses, i.e., residential dormitories, and Category I uses, the Mall and other outdoor areas. In addition, noise sensitive research is conducted on the campus.

Mitigation Plan and Standards

MTA has charted two Purple Line alignments through the University: the Campus Drive route and the Preinkert Drive route. Unless MTA mitigates EMI and vibration *at their sources*, Light Rail traffic will cripple the University's research capabilities. The AA/DEIS, must develop and incorporate a mitigation plan at the sources (train/track system) that meets sensitive equipment standard for both (i) design and (ii) operation of the system through the campus. To prevent unnecessary disruption of ongoing and future campus research, the University needs to review and comment on the mitigation in the design and operation plans before their adoption and it also wishes sufficient time for its experts to review and comment on the plans.

Taking into consideration the location of dedicated research facilities, present and planned, and the nature of work conducted there, a committee of University research faculty has concluded that to preserve the University's research potential now and into the future, the following limits, *which conform to average current background conditions*, cannot be exceeded.. These limits must be met by mitigation and operation at the source. The different setbacks for the two alignments reflect differences in the distances from the alignments of current or planned University buildings in which research dependent on sensitive instrumentation takes place.

Alignment	Maximum Allowable EMI	Maximum Allowable Vibration
Preinkert Drive	**0.15 mG at 300' from track**	**NIST-A at 300' from track**
Campus Drive	**0.15 mG at 100' from track**	**NIST-A at 100' from track**

The Purple Line could also affect research in the University's Research Park currently being completed east of Route 1. We have not studied the soils there to permit estimates of vibration propagation. We would accept Preinkert Drive standards for EMI and vibration at the Research Park, as they will allow us to develop the Park in accordance with the research requirement of our Federal and industrial tenants. The DEIS should include a mitigation plan for University review and comment for this section of the Purple line.

In addition to the EMI and vibration limits, acoustical noise must be addressed by a plan to meet FTA guidelines for Category 2 and Category 1 areas where appropriate and to address noise sensitive research. The University will work with the MTA to define these areas.

Preinkert Drive Alignment

The University believes technology exists capable of mitigating EMI and vibrations along the Preinkert Drive alignment to within the NIST-A and VC-G standards and the manufacturers' specifications for sensitive instruments required by our research program and faculty. The location and use of existing and planned facilities on the Preinkert route and the differences in soil permit a 300 foot zone to meet these standards. However, the University does not believe technology exists to mitigate EMI and vibrations along the Campus Drive alignment to the standards required by our research programs and faculty because the proximity of current science buildings and future building sites and soil conductivity allow only 100 feet to meet the standards.

The University believes the Preinkert alignment is better suited to the long-term orderly development of the campus. This alignment is consistent with and fulfills the University's Master Plan. The Preinkert alignment would introduce a new, dedicated transportation route for commuter lines, including Metro buses and University shuttle buses, near the edge of the campus. The Master Plan goal of closing Campus Drive to through traffic could be fulfilled. Not only would this alignment enhance a quiet research environment, it would also create the pedestrian friendly central core of campus envisioned by the Master Plan.

As proposed, the Preinkert Drive alignment traverses the campus above ground. The high pedestrian flow at known points of the route suggests that the portion of track between the Chapel on Chapel Drive and Morrill Hall near Preinkert Drive be run underground. This would have the additional significant benefit of eliminating airborne noise impact along the underground segment. MTA has considered an underground alignment for a segment of Campus Drive. The University requests MTA to consider a similar underground alternative for the Preinkert Drive alignment through this short section of its route across campus.

Construction and Operating Agreements

The choice of an alignment and the development of an approved mitigation plan do not end the University's concern about the impact of the Purple Line. The University has asked the Regents to ensure that the MTA enter into both a construction agreement and an operating agreement with the University before the Regents grant access to the MTA or any others to construct a regional transportation system on University land. Construction must be managed to ensure the University can continue its educational and research activities unhindered, and an operating agreement sets up the long-term conditions for the operation of the Purple Line across campus, such as maximum speed, pedestrian right of way, adherence to campus traffic control, access to the alignment during emergencies and major campus events, and a plan to monitor both EMI and vibrations to ensure conformance with the mitigation plan and university standards.

Summary of Key Requirements

The National Institute of Standards and Technology (NIST) moved to Gaithersburg in part because it could no longer accomplish its research mission in the high traffic environment of Washington, DC. The University cannot move. Therefore, the Purple Line planning must acknowledge and accept the protection of the University's research environment now and into the future as an absolute requirement of the construction and operation of the cross-county transit system.

Specifically, fulfilling the following requirements for the Purple Line are mandatory:

1) The Environmental Impact Statement must incorporate a plan that mitigates the EMI, ground vibration, and airborne noise *at their sources* to the levels specified in this document for the selected alignment through campus.

2) The Environmental Impact Statement must incorporate a plan that mitigates the EMI and ground vibration *at their sources* at the Research Park at the levels specified by the faculty for the Preinkert alignment.

3) The University demands the opportunity to review and comment on the complete EMI, vibration, and airborne noise mitigation plans for the campus and the Research Park alignments. Sufficient time must be allocated for this review to allow comment by consultants.

4) Before the USM Regents authorize the construction of a regional transportation system on University land by the MTA or any others, the University must approve both the construction plans and the agreements for operations now and into the future that will maintain an environment suitable for the research programs and campus environment.

5) The University recommends the MTA consider adding an underground alternative section to the Preinkert alignment as they have done for the Campus Drive alignment to reduce the Purple Line's environmental disturbance and to decrease travel time across a campus dominated by pedestrian traffic.