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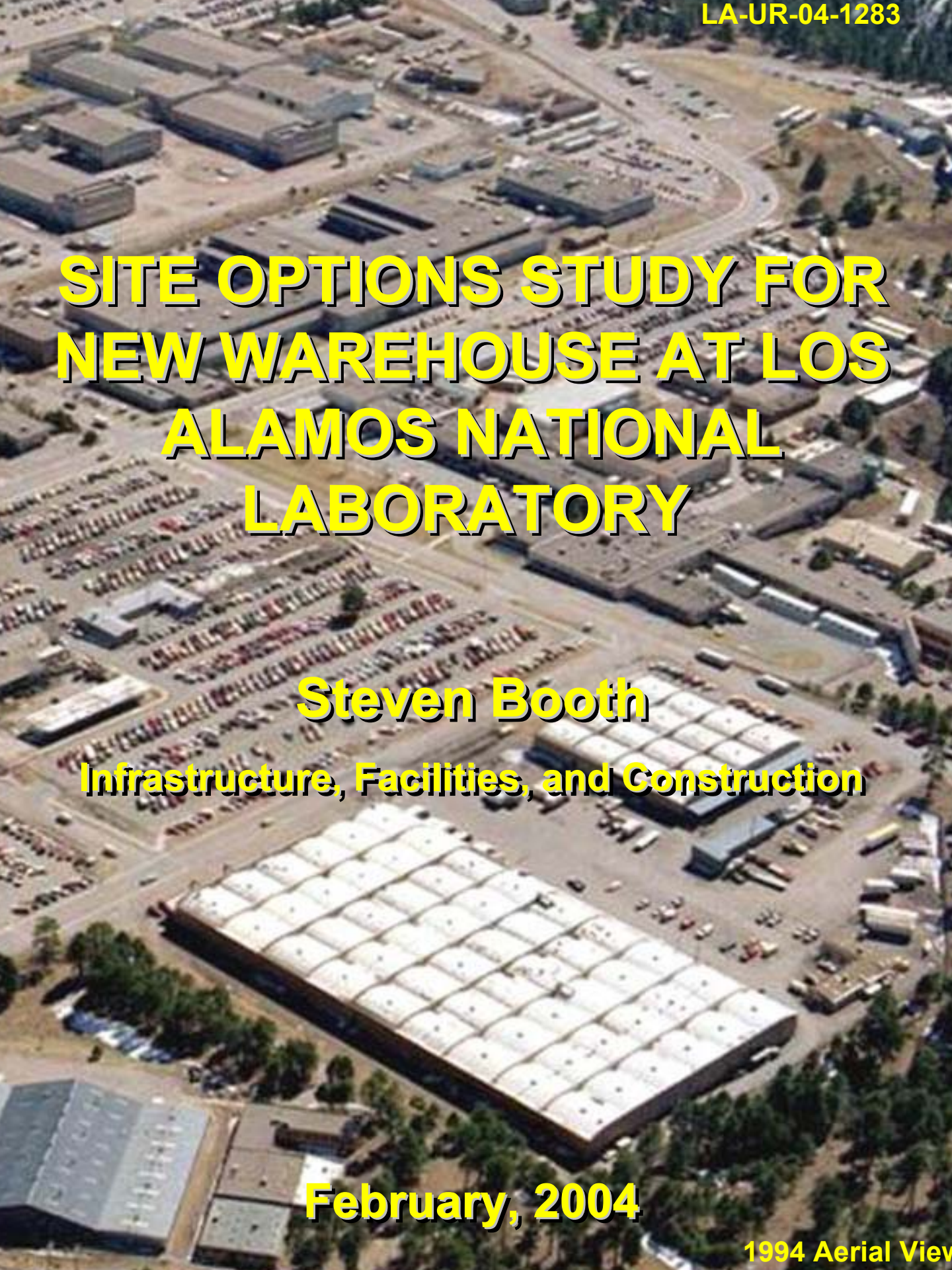

SITE OPTIONS STUDY FOR NEW WAREHOUSE AT LOS ALAMOS NATIONAL LABORATORY

Steven Booth

Infrastructure, Facilities, and Construction

February, 2004

1994 Aerial View

Illustrations:
Front Cover – Aerial view of current warehouse, SM-30 (foreground), circa 1994.

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Background

The effort to relocate the present LANL warehouse (building SM-30) to a new site outside of TA-3 has a significant history spanning many years. Most recently, nine location options were considered in a PM-1 warehouse relocation siting study of February 8, 2002.[1] The new design basis threat coupled with the LANL/NNSA security position of keeping large private trucks out of core and sensitive LANL areas makes removal of the current SM-30 warehouse activities in TA-3 more important than ever. A consideration will be needed of what interim measures can be quickly implemented in addition to the longer-term solution of relocating the warehouse. A team was formed in early FY04 to reconsider sites for the new warehouse.

The Perimeter Security Project line item is still being defined. Currently the plan is to have three access stations around the lab. One may be at the old "Back Gate," near the corner of West Jemez Road and NM 4. A second may be the current location at the east end of Pajarito Road near NM 4. The third is proposed for the top of East Jemez Road near intersection with Diamond Drive.

From S-DO's perspective, the warehouse should be located outside the perimeter, but as close to it as possible. The goal would be to have un-cleared trucks enter the center to unload, then (after inspection) smaller government trucks/vans with cleared drivers would distribute the goods throughout the lab. If the distribution center were located right on the perimeter, un-cleared trucks would go in the front and cleared vans would travel out the back. Security expense would be minimized by this option. If the warehouse were some miles outside of the perimeter and the government vans still had to drive on public roads before entering LANL, security risks of high jacking or tampering would still be present. Some security apparatus

[1] "SM-30 Relocation Proposal," Prepared by Site & Project Planning Group, February 8, 2002.

to protect the vans or monitor their progress via electronic seals would be needed, adding to costs and inefficiencies.

Given these factors, off-site options in Espanola, Pojoaque, and Totavi are not considered in this siting report. Currently, ten sites are under consideration (see Figure 1).

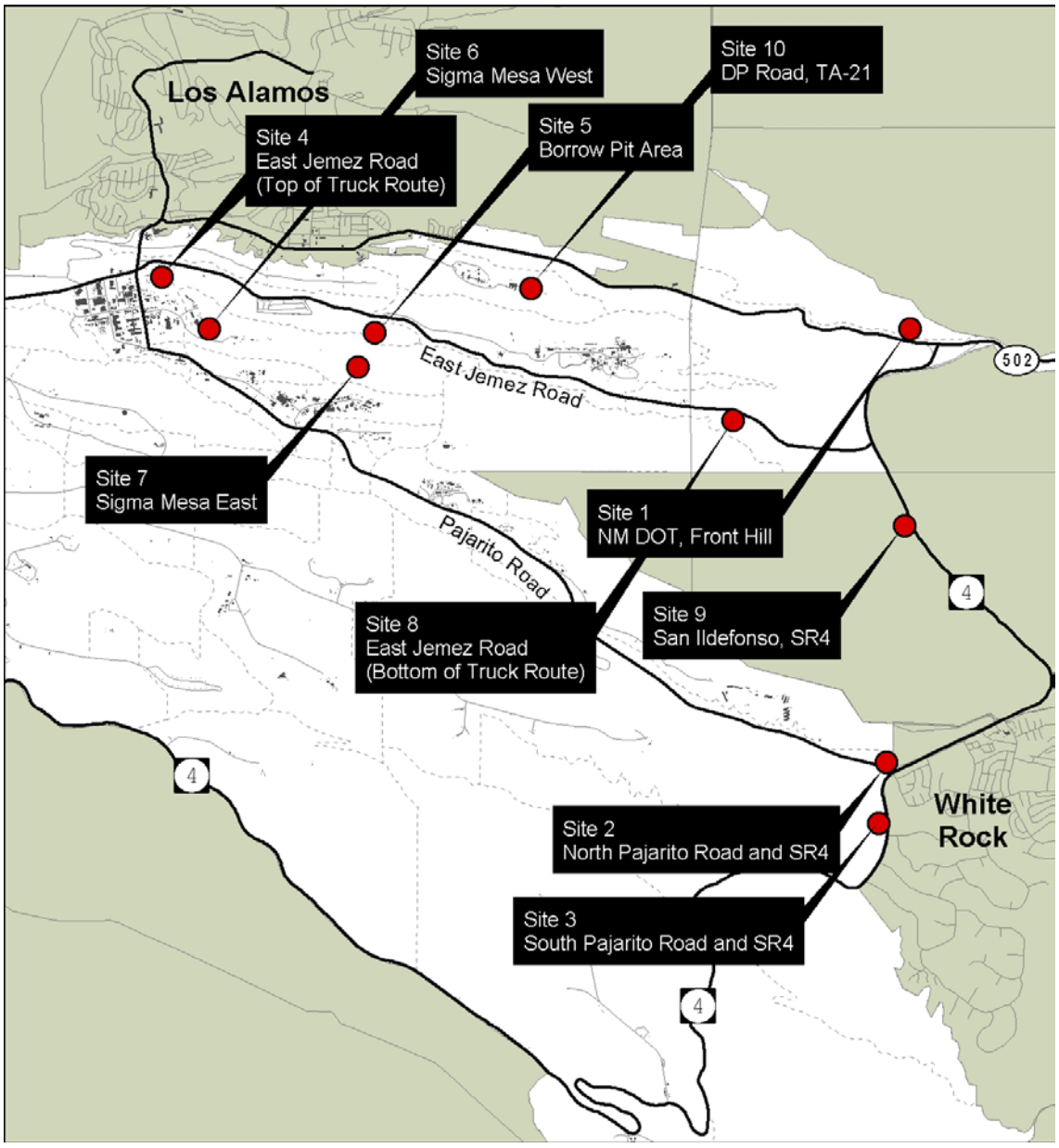

Figure 1: Overview of ten possible warehouse sites.

Possible Warehouse Sites

Site 1: NM 502 and NM 4, near Department of Transportation Site

This site at the bottom of the "front hill road" is part of a tract slated for land transfer and therefore would entail an agreement with the Los Alamos County (see Figure 2). For example, perhaps LANL could agree to build the utility infrastructure to the area to allow the County to move their distribution/warehouse facility to the area in exchange for some acreage for LANL's warehouse. Another possibility is LANL could lease the land/facility from the county. Given political overtones of this site with respect to the land transfer process, I would expect difficulties in getting

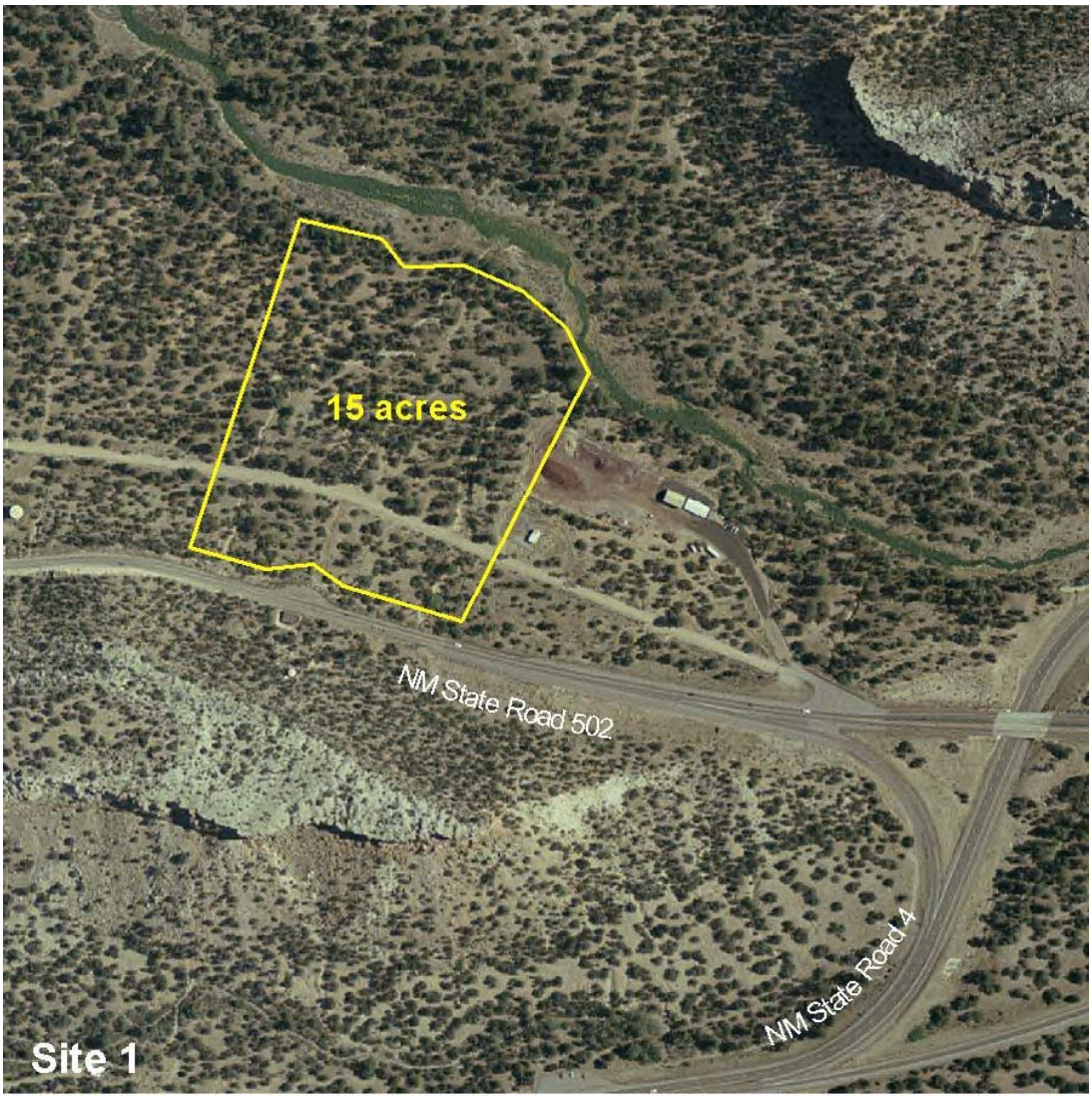

Figure 2: (Site1) The DOT site is located at the bottom of the main hill road NM 502 near the White Rock "Y."

NNSA and LANL management agreement to any land re-swapping or re-use option. However, the option to have the County develop their land with a warehouse that could be leased to LANL would generate tax revenues. Traffic issues are a concern because of the high-speed nature of the intersection mixing with large semi-trucks using the warehouse.

Sites 2 and 3: Pajarito Road/NM 4, North and South

These two sites are located near the intersection of Pajarito Road and NM 4 (see Figures 3 and 4). The benefit of this intersection is its location on the perimeter of NNSA property. Since Pajarito Road is no longer open to the

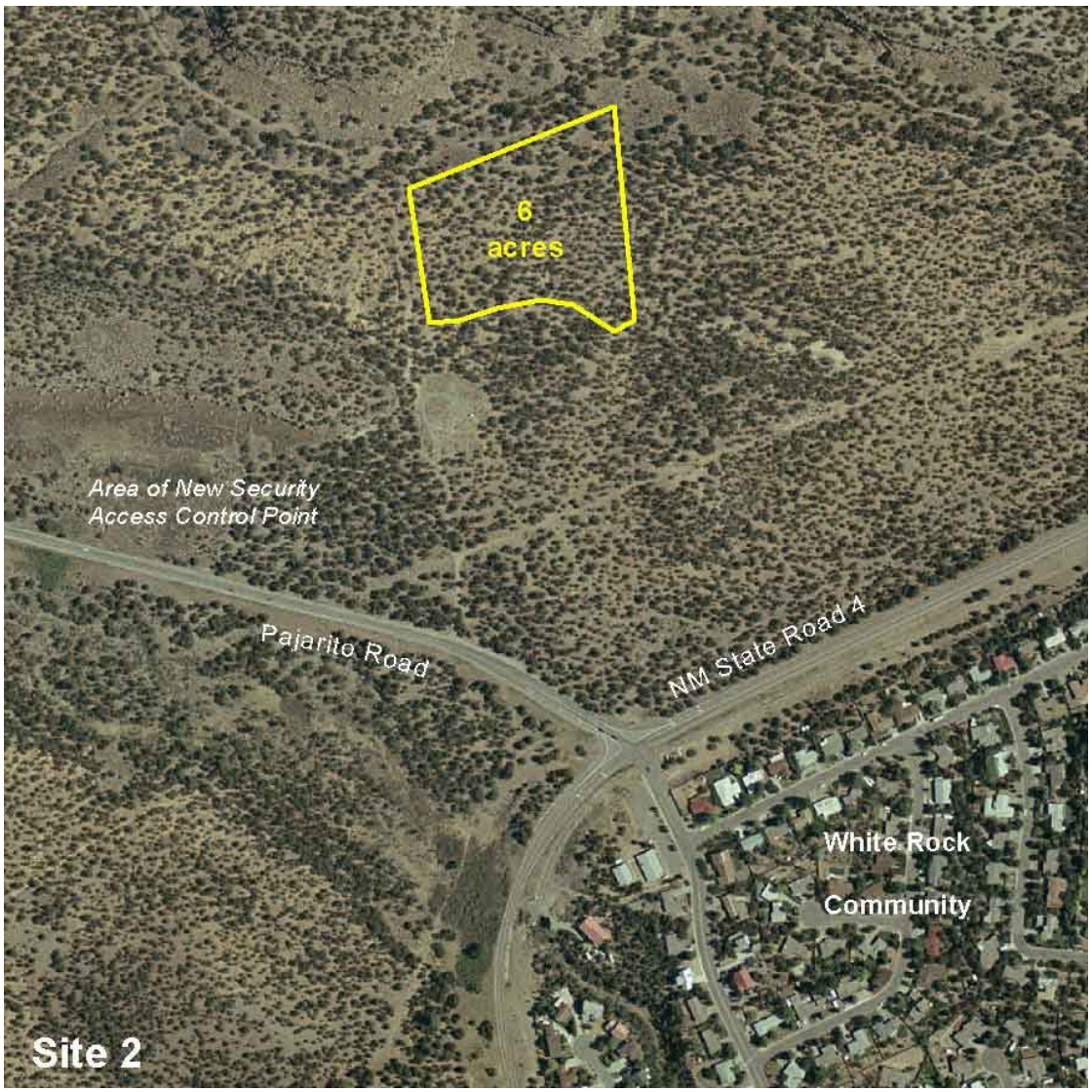

Figure 3: (Site 2) The intersection of Pajarito Road and NM 4 provides easy access to utilities and is at the edge of the LANL perimeter.

public, government distribution vans exiting the distribution center will travel on protected roads being constructed to the west of the intersection, so warehouse-support infrastructure and utilities will be easier to establish that the other more remote sites. Large trucks would still need to use E. Jemez Road because of the steep and curvy two-lane hill on Pajarito Road.

Figure 4: (Site 3) Pajarito South is directly across the street from a residential area.

The warehouse could be on either the south or the north side of Pajarito Road. The south site lies within TA-36, and DX Division would have to be interviewed to see if this location would impact their explosives operations.

There may be wetlands issues and the flycatcher nesting area to consider also. On the north side there are two towers (radio and meteorological). There is barely sufficient land to locate the warehouse on this side (6 acres) because of the archeological sites plus the traffic access control area.

Land use is mixed in the Pajarito Road/NM 4 Intersection area. Residential property is to the south-east, commercial activity lies within one quarter mile to the east (e.g., Smiths grocery store), and undeveloped land is to the north

Figure 5: (Site 4) The top of Truck Route would locate the new distribution center near the perimeter of LANL as defined by the access center and badge office.

and west.

Newly-transferred county land is to the north. Plans and zoning for this land are not yet determined, but are expected to focus on commercial with perhaps some residential. We should expect some public dissent toward these sites, especially Site 3, because of increased truck traffic through White Rock's main vehicle arteries and proximity to residences. Also, the location is about four miles further each way for trucking to access the Truck

Figure 6: (Site 5) The Borrow Pit site lies just south of the LANSCE entrance.

Route.

Site 4: E. Jemez Road near new Badge Office/Inspection Station at Diamond Drive

This would locate the warehouse near the yet-to-be-built access station at the security perimeter, so lab distribution vans would exit the center onto protected NNSA property (see Figure 5). No additional inspection expense would be needed. The key issue with this site is whether or not there is enough land for the warehouse. To make sufficient space other uses would have to be moved such as the concrete plant, which would be difficult. Lots of project coordination would be needed for the warehouse to fit into this

Figure 7: (Site 6) Sigma Mesa West as laid out by PM-1's original siting study in February 2002. A more eastern location might be better given the new DBT.

project-rich area.

Site 5: TA-61 Borrow Pit

This site is located just south of the entrance to the LANSCE complex. See Figure 6. It is bounded on the north and east by East Jemez Road, on the south by Sandia Canyon, and on the west by the Royal Crest Trailer Park. There are approximately 25 developable acres at this site accessible from East Jemez Road. The existing borrow pit visibility screen provided by the knoll could probably be preserved while still allowing adequate acreage for the warehouse. The Comprehensive Site Plan 2000 has identified the future land use of this area as Physical/Technical Support. Although currently dump trucks use this site sporadically, significant road improvements would be needed to allow a warehouse operation.

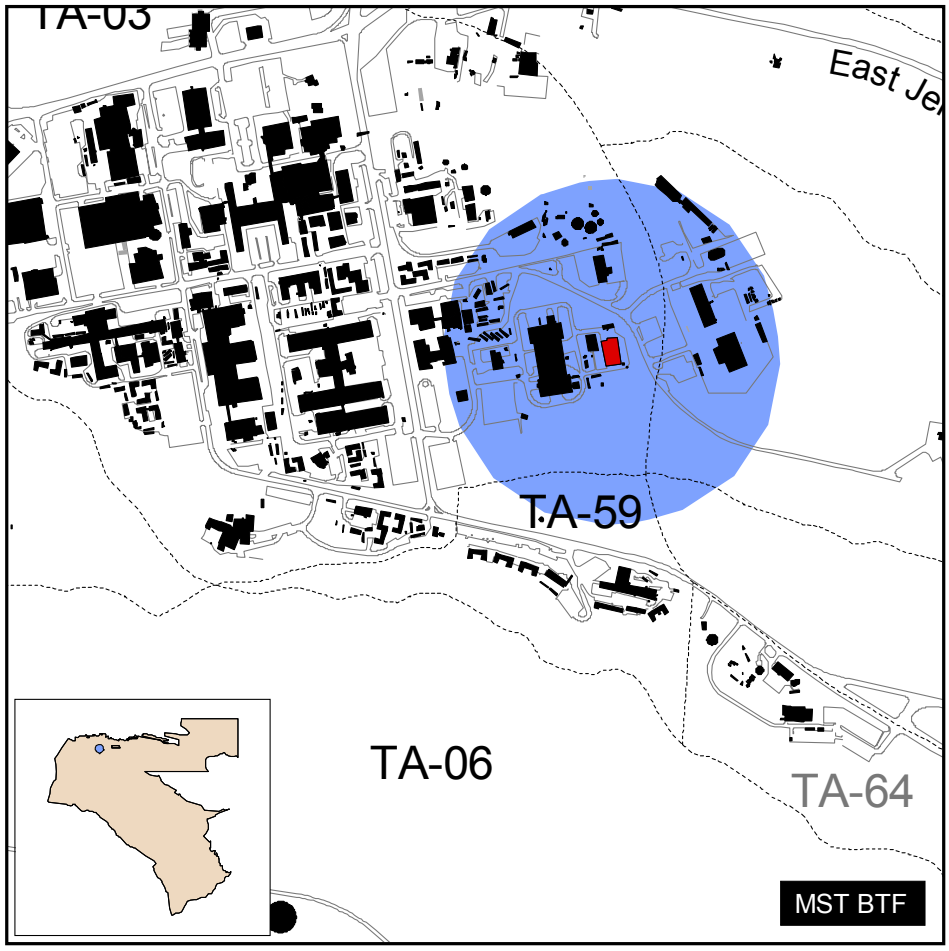

Figure 7a: A one-thousand foot set-back from the Beryllium Technology Facility shows that it would be difficult to find space for a new access road to Eniwetok Dr. by crossing the rubble-fill bridge at the head of Sandia Canyon.

Sites 6 and 7: Sigma Mesa West and East

The Diamond Road to Eniwetok intersection will be unavailable to un-cleared trucks, so using Sigma Mesa for the warehouse will necessitate the building of an access road from East Jemez Road. The warehouse would be an appropriate land use for Sigma Mesa, which is slated for industrial use in LANL plans. A new access road would open the mesa to full development for industrial use per the plans. Without the road, such development is difficult given the current security climate. The mesa is close to the core of the lab and it has no conflict with other science areas.

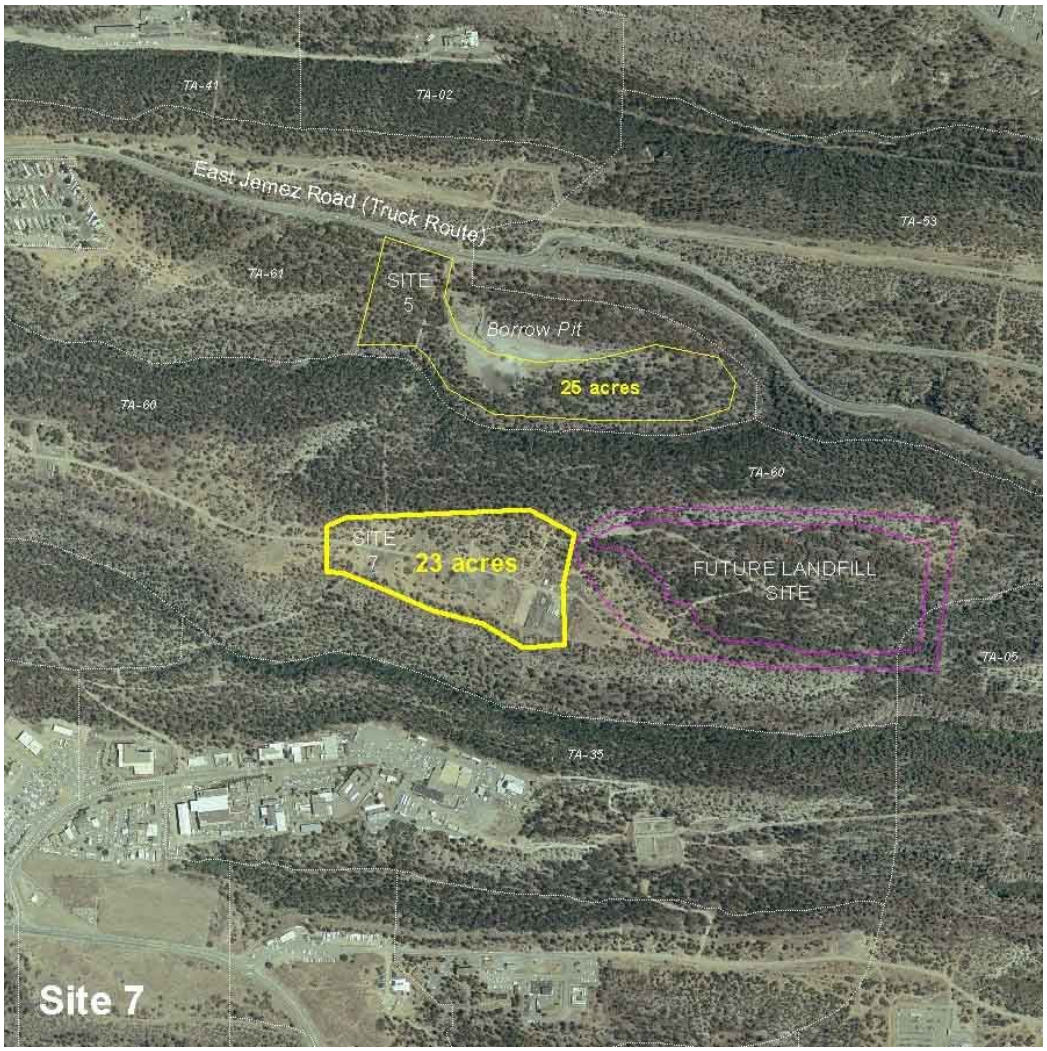

Figure 8: (Site 7) "Sigma Mesa East" conceptual location for possible warehouse location on eastern location might be better given the new DBT.

The Sigma Mesa West site lies directly to the east of TA-3 bounded on the north by Sandia Canyon and on the east by the rack facility (see Figure 7). Sigma Mesa East could be located somewhere between the rack facility and the eastern end of the mesa, before the Sigma Mesa shelf where the landfill is being considered. There is flexibility on the exact placement of the warehouse, and there is sufficient acreage (see Figure 8).

Three options for the access road exist. All of these would also provide access for a new County landfill if it were to be constructed on the eastern end of Sigma Mesa (one of the two sites being considered in the NNSA landfill environmental assessment) and for future LANL industrial use of the mesa. One road option is to cross Sandia Canyon on the rubble fill bridge near the present landfill and build a road along the south side of the canyon or on the mesa to reach the new warehouse. Building the road with adequate safety set-back from the Beryllium Technology Facility (BTF) will be an issue. Another option is to bridge the canyon to the south of the Borrow Pit and connect with Eniwetok Road. If the landfill were built on Sigma Mesa, this bridge would serve both types of truck traffic. The garbage trucks would cross the bridge and turn east on Eniwetok to the landfill, and delivery trucks would turn west to the distribution center. The third option is to build a road up the tail of Sandia Canyon or the landfill ravine that intersects East Jemez east of Sigma Mesa. All three road options would allow un-cleared trucks to enter and exit the mesa from the public road, never having to pass onto NNSA property.

Site 8: East Jemez at NM 4.

This site is located near the base of the Truck Route (see Figure 9). It is expected that East Jemez Road will remain open to the public. Because of the distance of this site to the perimeter, electronic seals and/or timers and other security methods might be needed to prevent terrorist tampering with the government trucks. Another inspection might be needed at the TA-3 access point, which would add expense. Depending on the precise location of the warehouse site, there may be cultural, environmental, or aesthetic issues. Security and emergency response time is adequate. Infrastructure for utilities, especially sewer, will be problematic.

This site to the west of the curve in E. Jemez Road would allow sufficient visual screening and set-back from the park and pueblo. There is sufficient space for the warehouse and a third-party building if desired.

Figure 9: (Site 8) Possible location of a new warehouse on East Jemez Road near NM 4.

Site 9: San Ildefonso Pueblo Property on NM 4 Between Jemez Road and White Rock

This option involves participation of a neighboring pueblo tribe. It may allow third-party financing where the pueblo develops the facility and leases it to LANL (see Figure 10). The location has issues similar to those with the Jemez Road/NM 4 location. Additional problems revolve around receiving,

storing and handling classified (both documents and equipment or parts) and hazardous (chemical or biological) shipments on pueblo land. My understanding is that State and Federal contract law and courts do not have jurisdiction over agreements with pueblo nations. Consequently, long-term facility lease agreements with pueblos have fewer legal protections than those with typical development firms. There remain questions of cultural or aesthetic impacts given to proximity to Bandelier and Pueblo ruins.

Figure 10: (Site 9) San Ildefonso Pueblo land along NM 4 near White Rock could be a desirable location for the new distribution center if legal issues of contracting with the pueblo can be addressed.

Figure 11: (Site 10) Twenty acres along DP Road could be used for a warehouse.

Site 10: TA-21 DP Road

Some of the land along DP Road may be transferred to the County after remediation. There could be space for a LANL warehouse to the east of the Tritium Science and Technology building TA-21-155 (see Figure 11). This option would require time for the TA-21 site to be decommissioned, demolished and remediated/certified for other uses. Another option is to have the county develop a warehouse on transferred land to the north of DP

Road just east of the Trinity Dr. intersection. Traffic safety will require a new intersection to allow trucks to use Trinity Drive and DP Road. Because NM 502 is unsuitable for heavy trucks, warehouse traffic would have to enter the county via E. Jemez Road and cross over the Diamond Dr. bridge to Trinity Dr.

Decision Analysis

The alternative warehouse sites were evaluated using multi-criteria decision analysis. The team relied on a software package called Criterium Decision Plus[2] to build the model and calculate the results. The Analytical Hierarchy Process (AHP) was used to organize the model. Figure 12 shows the analysis steps used in the evaluation. My discussion below is organized along these steps also. Table 1 lists the team membership.

During the first step of the process, "Brainstorming," the team defined the goal of the exercise (*Select Warehouse Site*) and discussed a multitude of possible evaluation criteria. We were careful to define each criterion to make it independent of the others.

TABLE 1
Roster of Warehouse Site Screening Team Members

Name	***Affiliation***	***Phone Number***	***E-mail Address***
Steven Booth (lead)	ADO/IFC	667-0990	sbooth@lanl.gov
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Patty Blount	S-1	667-5181	pblount@lanl.gov
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Craig Othmer	Legal Council	667-3766	cothmer@lanl.gov
Kevin Boyd	S-5	665-3430	kboyd@lanl.gov
Dan Pava	RRES-ECO	667-7360	dpava@lanl.gov
Amy Nuckols	ADA	665-6530	anuckols@lanl.gov
Jim Mork	LANL/PM-1	665-1331	jmork@lanl.gov
Joan Stockum	PM-1	665-4155	jstockum@lanl.gov

[2] Infoharvest, Inc., Seattle, WA, www.infoharvest.com.

After narrowing the list of criteria, the team built the hierarchy. In this step the structure of the model is produced as shown in Figure 13. The goal of selecting a warehouse site is on the left side. Next are listed the five top-level criteria that help attain the goal. Each of these criteria has two or three independent sub-criteria that are used to score the alternative sites. The right side of the hierarchy chart lists the ten possible sites. Note that each site alternative is connected through the eleven sub-criteria to the goal. This shows graphically that the alternatives are scored against all of these sub-criteria.

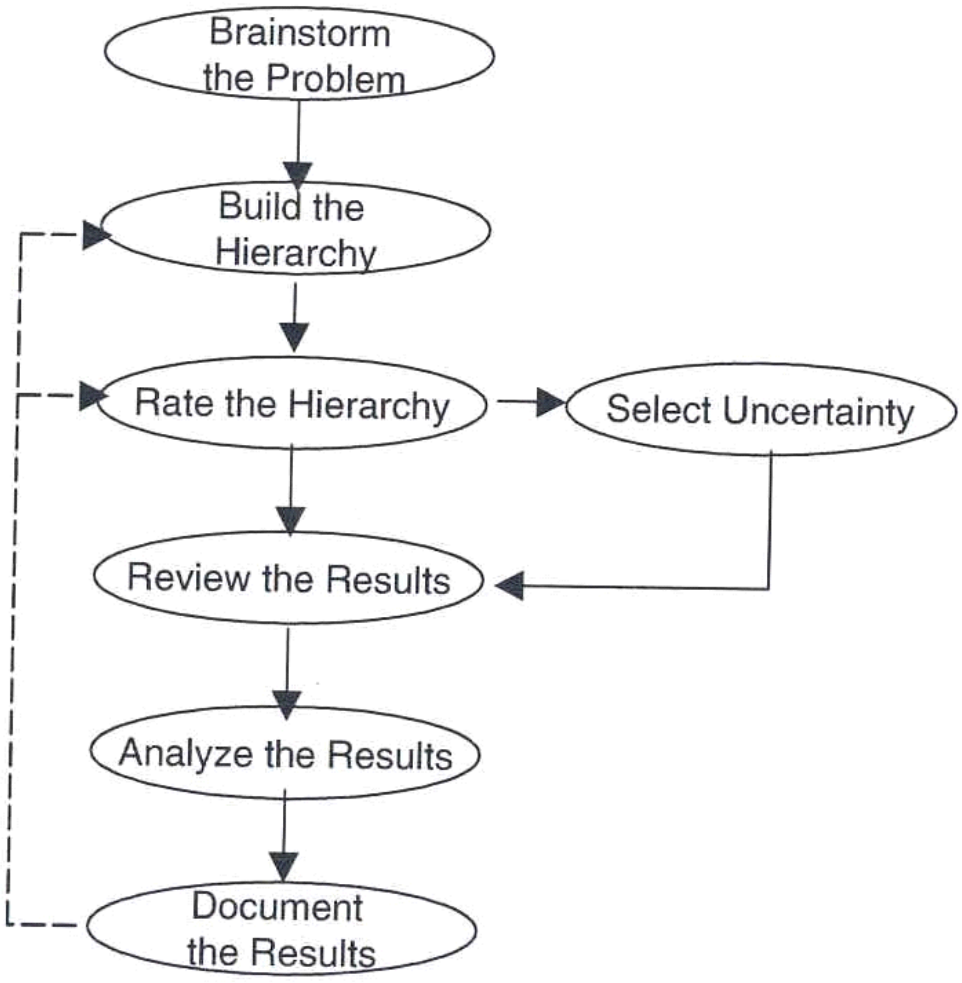

Figure 12: Warehouse site evaluation followed standard decision analysis steps.

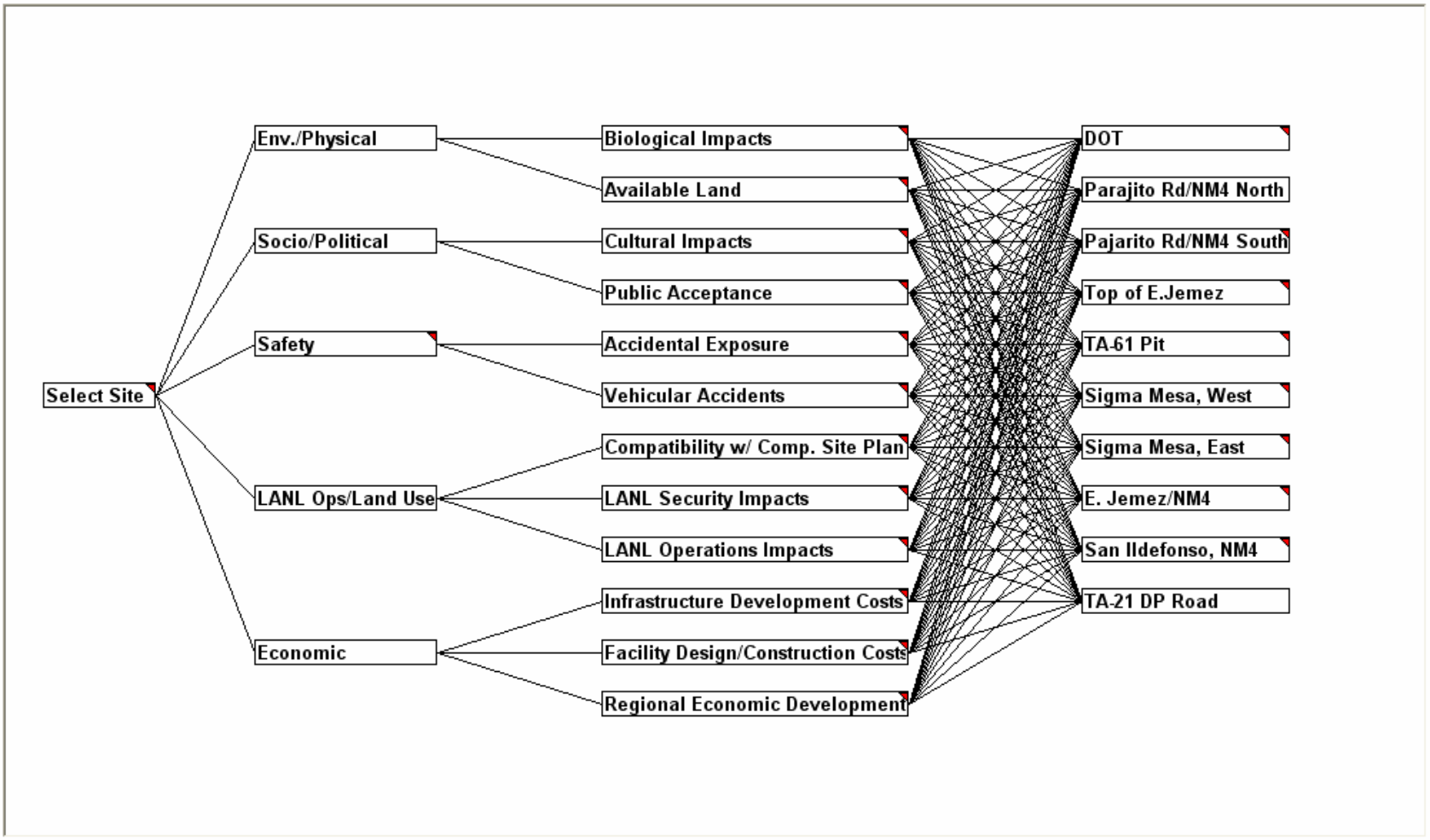

Figure 13: The model's hierarchy shows the goal at the left and the alternatives to achieve that goal on the right, with the evaluation criteria in between.

Definitions

Each component of the model is clearly defined to facilitate accurate scoring of alternatives.

Goal: Select Warehouse site

The task is to select one or more sites that can be approved by LANL's AD-Operations and recommended to DOE/LASO for possible use as a warehouse developed by a third party.

Environmental/Physical Sub-Criteria

Biological Impacts. Considers plant or animal impacts and known endangered species or their habitat at the site.

Available Land. Considers the size of the site in terms of the required space for the warehouse, yard, and potential third-party uses.

Socio/Political Sub-Criteria

Cultural Impacts. Considers the presence of historical sites, both ancient and homestead eras.

Public Acceptance. Considers the presence of buffer zones for noise/odor abatement, vegetation and topography for visual shielding.

Safety Sub-Criteria

Accidental Exposure. Considers how close the site is to populated areas, such as technical areas, residential areas, and the town site. The warehouse has hazardous and bio/rad materials that possibly could place nearby population at risk.

Vehicular Accidents. Considers risk to public safety of vehical accidents. The number and size of trucks coupled with road capacity, speed limits, and the nature of traffic (e.g., industrial versus residential) of the access roadways are important factors to be considered here.

LANL Operations/Land Use Sub-Criteria

Compatibility with Comprehensive Site Plan. Considers possible conflicts with current LANL site plans. Land that is

already committed to other uses, depending on how far along those commitments are, will be downgraded.

LANL Security Impacts. Considers potential impacts on LANL security.

LANL Operations Impacts. Considers potential impact on on-going and future Lab operations. Divisions that "own" the LANL area in question will be interviewed to understand these issues. Hazards and buffer zones will be defined. Mitigation strategies may be negotiable with impacted divisions. Considers the location in terms of warehousing efficiency.

Economic Sub-Criteria

Infrastructure Development Costs. Considers the cost of installing required infrastructure up to the warehouse site. This includes roads, water, natural gas, sewer, and telephone/communications.

Facility Design and Construction Costs. The cost to build the warehouse. These costs will be imputed into the lease cost that LANL must pay. This is relevant as a sub-criterion only if there will be differences between the development costs among the sites.

Our current thinking is that the private developer will not have to perform to LANL LIRs and engineering standards, even if building on NNSA land. Therefore, this sub-criterion does not have much relevance because all sites will have similar construction costs. Christopher Webster confirmed this assumption is being used also for the Strategic Research Directorate's Two-Mile Mesa project. However, if the developer does have to follow more expensive standards on NNSA land, then this will be relevant in comparing NNSA sites to the San Ildefonso or county sites, which clearly will not have those extra expenses. For this paper, I assume no special requirements (e.g., LIRs) will be in place on any site. So the only difference in cost will be because of site anomalies. These will occur because of different geologies that force construction changes. Since I don't have detailed geotechnical information at

this point, I cannot identify significant construction cost differences among the sites and all the scores will be the same, "average." Therefore, this sub-criterion adds no fidelity to the model, and I deleted it from the analysis.

Regional Economic Development. Considers the warehouse site from the point of view of potential third-party financers or partners. That is, how desirable is the site for the partner's activities, e.g., United States Postal Service (USPS)? How much additional economic development is stimulated by the location?

Rating the Hierarchy

The next step in the decision analysis process is to rate the hierarchy, i.e., apply weights to the criteria based on relative importance and score the alternatives against each sub-criterion. Those products are then summed over all the sub-criteria to provide a total decision score, thus serving as a measure of how well the alternative fits our decision model.

Weights

The weights of the criteria with respect to the goal were chosen by the Siting Team based on a descriptive scale with points attached: Critical (100 points), *Very Important* (75 points*), Important* (50 points), *Unimportant* (25 Points), and *Trivial* (0 points). (See Table 2.)

Although the eleven sub-criteria are all weighted as "Important" with a value of 50 points, the normalized weights can be different as shown in Table 3. This is because the normalization takes account of the number of sub-criteria under each top-level criterion. For example as shown in Table 3, Environmental/Physical has two sub-criteria that are valued with 50 points. Each sub-criterion's normalized weight is calculated as 50/(2x50)= 0.5. In a sense, the influence of Environmental/Physical is divided into two "sub-influences" represented by the sub-criteria. On the other hand, the top-level criterion LANL Operations/Land Use has three sub-criteria. Therefore its influence on the total is split into three components, leading to a weight of 0.333 for each sub-criterion.

TABLE 2
Computing Normalized Weights for Top Four Criteria

Criterion	*Descriptor*	*User Scale Value (0 to 100)*	*Normalized Scale Value (0 to 1.0) [1]*
Environmental/Physical	Important	50	0.167
Socio/Political	Important	50	0.167
Safety	Very Important	75	0.250
LANL Ops/Land Use	Very Important	75	0.250
Economic	Important	50	0.167

Note 1: This scale adds to 1.0. Computed by dividing the single criterion's weight by the total of all weights, e.g., 50/(50 + 50 + 75 + 75 + 50) = 0.167.

The software automatically calculates the accumulated weight for each path in the hierarchy that connects the alternative to the goal. This is done by multiplying the top-level criterion's normalized weight by that of the sub-criterion along the path. For example, Biological Impacts is sub-criterion of Environmental/Physical. The top-level weight is 0.167 and the sub-criterion weight is 0.5, so the accumulated weight along the path of the hierarchy is 0.167 x 0.5 = 0.083. The total of the eleven accumulated weights is 1.0.

Scores

Each sub-criterion was scored with respect to the ten alternative sites using a descriptive scale ranging from 100 to zero: *Finest* (100 points), *Excellent* (83.3 points), *Above Average* (66.7 points), *Average* (50 points), *Below Average* (33.3 points), *Poor* (16.7 points), *Unsatisfactory* (0 points). The reasoning behind these scored is described below; the scores are listed in Table 4.

Environmental/Physical Sub-Criteria

Biological Impacts. *Site 1, DOT* has no threatened and endangered species (T&E) problems, only some possible wetland issues; "excellent." *Site 2, Pajarito Road/NM 4-North* is close but not inside of willow flycatcher habitat, and has some water drainage and so wetland issues; "excellent." *Site 3, Pajarito Road/NM 4-South* is located just outside of wetlands, the flood plain, and the core and buffer flycatcher habitat; "excellent." *Site 4, Top of E. Jemez Road* site is located inside a

developed spotted owl habitat; "average." *Site 5, Borrow Pit* is inside core and buffer owl habitat; "below average." *Site 6, Sigma Mesa West* is in the developed buffer for owl. *Site 7, Sigma Mesa East* is in undeveloped owl buffer area. Both these sites require new roads through core area causing significant disturbance; both score "poor." *Site 8, E. Jemez/NM 4* has no T&E problems, but some wetland and flood plain issues; "excellent." *Site 9, San Ildefonso* area has flood plain and wetland issues that can be avoided. No T&E issues. It scores "finest" because it is private rather than NNSA land and may have the most flexibility with respect to T&E. Site *10, TA-21 DP Road:* developed and undeveloped habitat for spotted owl; "below average."

TABLE 3
Weights of Sub-Criteria

Criterion	***Descriptor***	***User Scale Value (0 to 100)***	***Normalized Scale Value (0 to 1.0)***	***Accumulated Value***
Biological Impacts	Important	50	0.5	0.083 [1]
Available Land	Important	50	0.5	0.083
Cultural Impacts	Important	50	0.5	0.083
Public Acceptance	Important	50	0.5	0.083
Accidental Exposure	Unimportant	25	0.333	0.083
Vehicular Accidents	Important	50	0.667	0.167
Compatibility with Comp. Site Plan	Important	50	0.333	0.083 [2]
Security Impacts	Important	50	0.333	0.083
LANL Operations	Important	50	0.333	0.083
Infrastructure Devel. Costs	Important	50	0.5	0.083
Regional Econ. Development	Important	50	0.5	0.083

Note 1: The accumulated weight for the two sub-criteria under Env/Physical is 0.5 x 0.167 = 0.083.
Note 2: The accumulated weight for the three sub-criteria under LANL Operations/Land Use is 0.333 x 0.25 = 0.083.

TABLE 4
Scores for the Ten Warehouse Alternatives

Sub-Criterion	*DOT*	*Pajarito North*	*Pajarito South*	*E. Jemez/ Diamond*	*TA-61 Pit*	*Sigma Mesa W.*	*Sigma Mesa E.*	*E. Jemez/ NM 4*	*San I.*	*DP Road*
Biological Impacts	83.33	83.33	83.33	50	33.33	16.67	16.67	83.33	100	33.33
Available Land	100	16.67	33.33	0	66.67	33.33	66.67	66.67	100	66.67
Cultural Impacts	100	0	16.67	83.33	100	66.67	66.67	66.67	100	100
Public Acceptance	83.33	50	0	83.33	100	100	100	66.67	66.67	100
Accidental Exposure	100	33.33	16.67	16.67	50	33.33	66.67	83.33	83.33	16.67
Vehicular Accidents	16.67	66.67	66.67	83.33	50	83.33	83.33	83.33	66.67	66.67
Compatibility with Comp. Site Plan	33.33	100	100	0	33.33	83.33	100	100	100	50
Security Impacts	16.67	83.33	83.33	16.67	83.33	50	83.33	83.33	16.67	16.67
LANL Operations	16.67	83.33	83.33	66.67	83.33	83.33	83.33	83.33	16.67	16.67
Infrastructure Devel. Costs	33.33	83.33	83.33	100	16.67	0	0	50	33.33	50
Regional Econ. Development	83.33	0	83.33	0	66.67	50	50	83.33	83.33	50

Available Land. The LANL warehouse building itself will need 2 acres, and the yard needs 2 acres. Adding one acre for parking (100 people) gives total of five acres. I assume that the gas plant is not included as part of the minimum requirement of space. I assume the third party partner will also need at least the same as ours: five acres. For example, the USPS as a partner might want its own distribution center on the same site. We do not *require* that available land be adequate for both LANL and the third-party. The regional economic development sub-criterion will capture whether or not a site is conducive to partnership development. A rule is used to monitor this criterion: if a site scores "unsatisfactory," then the rule is violated and the option is dropped from further consideration. In other words, Available Land serves as a Go/No Go criterion in the model.

More space will allow flexible placement of the building on the site. This criterion must capture the issues of seismic, floodplain, topography, etc. Consequently, larger sites will be scored higher than smaller sites. If less than 5 acres: "unsatisfactory." If from 6 and 10 score is "poor;" 11 to 15 score "below average;" 16 to 20 is "average;" 21 to 25 is "above average;" 26 to 30 is "excellent," greater than 30 is "finest." *Site 1, DOT site:* Over 100 of developable acres scores "finest." *Site 2, Pajarito Road North:* 6 acres, "poor." *Site 3, Pajarito Road South:* 13 acres, "below average." *Site 4, Top of E. Jemez:* 1.5 acres, "unsatisfactory.*" Site 5, TA-61 Pit:* 25 acres, "above average." *Site 6, Sigma Mesa West:* 14 acres; "below average." *Site 7, Sigma Mesa East:* 23 acres; "above average." *Site 8, E. Jemez/NM 4:* 22 acres; "above average." *Site 9, San Ildefonso:* over 30 acres, "finest." *Site 10, DP Road:* To gain all available land, must D&D buildings and gain access. Without D&D we have 21 acres; "above average."

Socio/Political Sub-Criteria

Cultural Impacts. *Site 1, DOT:* This site has no cultural issues and has been surveyed so there will be no surprises; "finest." *Site 2, Pajarito Road North:* this site is located in an area of significant pueblo ruins, both along south-facing cliffs and in the talus to the south; "unsatisfactory." *Site 3, Pajarito Road*

South: Avoids significant ruins; "average." *Site 4, Top of E. Jemez:* no cultural issues directly on site, but the nearby wooded area by the University House is considered sacred land. This caused some complaints from the pueblo when another nearby project was considered; "excellent." *Site 5, TA-61 Pit:* no cultural issues within the site; "finest." *Site 6, Sigma West:* "above average." *Site 7, Sigma East:* same as western site; "above average." *Site 8, E. Jemez/NM 4:* No big problems where we are planning the site; "above average." *Site 9, San I:* we have no information on this area. The pueblo will determine these issues and will find a plot to avoid the problems. Their rules and regulations are different. Elmer Torres could be a source. Score it as "finest" for now. *Site 10, DP Road:* one Manhattan Project-era building is in the area, but we think it is west of where we are planning for the warehouse. All the area has been developed by now, so there are no remaining cultural sites of concern; "finest."

Public Acceptance. *Site 1:* The DOT site would be sheltered, but it is the "front door of county." Being at the bottom of the canyon, commuters could perhaps see it from the roadway. But no houses can see it, and actually it would be hard to see from road. Overall, "excellent." *Site 2, Pajarito Road North:* although it is close to White Rock residences, Kirt expects no problems from public. Our site would be visually screened by the newly-transferred county land. But because of the truck noise from operations, score is "average." *Site 3, Pajarito South:* this is the worst site because it is in full view of White Rock and the houses across NM 4; "unsatisfactory."

Site 4, Top of E. Jemez: The site would be part of an access control site, and therefore would be less obtrusive. No residential public problem. But employees might complain because of increased noise and activity; "excellent." *Site 5, TA-61 Pit:* should be able to shelter it from view. We expect to preserve the screening knoll to the north; "finest." *Sites 6 and 7, Sigma Mesa West and East* are both sheltered from view. New road access to Sigma Mesa from East Jemez Road will cause no issues. The west site is across the canyon from Royal Crest. But

there should be no major change to their present environment; both Sigma sites score "finest."

Site 8, E. Jemez Rd./NM 4: Because the site area is beyond the road curve and is screened from view from hiking areas, the score is "above average." *Site 9, San I:* Land would be along the NM 4 road, but not near any residences. What would pueblo natives think? Same score as E. Jemez/NM 4; "above average." *Site 10, DP Road:* Considered by the public as the County's industrial area; "finest."

Safety Sub-Criteria

Accidental Exposure. The warehouse has hazardous, biological, and radioactive materials that could place nearby population at risk in case of explosion or fire. But the risk is actually very low per Carol Smith. For this reason the weight on this sub-criterion is lower than for the others.

Site 1, DOT: no population nearby; "finest." *Site 2, Pajarito Road North:* near to White Rock; "poor." *Site 3, Pajarito Road South:* directly upwind of White Rock, with no buffer; "unsatisfactory."

Site 4, Top of Jemez Road: Very populated and congested area. Has town site plus employees in vicinity; "poor." *Site 5, TA-61 Pit:* quite secluded, but is located in vicinity of LANSCE and Royal Crest; "average." *Site 6, Sigma Mesa West:* Close to TA-3 activities; "below average." *Site 7, Sigma Mesa East:* Site is more secluded from the LANL work population concentration as we move east down the mesa; "above average."

Site 8, E. Jemez/NM 4: Lots of commuters plus National Monument nearby, but no steady population in vicinity; scores a little below DOT; "excellent." *Site 9, San I:* Same score as the bottom of the Truck Route; "excellent." *Site 10, DP Road:* Lots of people in vicinity working, residential to the east. Same score as Top of Jemez Road; "poor."

Vehicular Accidents[3]: *Site 1, DOT:* This is a very poor intersection for large trucks because of high speeds, congestion, and geometry. The intersection is designed for high-speed through traffic for easy access to the Main Hill and the Los Alamos town site. There are no traffic control devices; "poor." *Sites 2 and 3, Pajarito North and South:* A four-lane road (NM 4) is large enough for big trucks and is controlled by traffic signals. However there is significant cross traffic, with about twelve commercial drive ways entering NM 4 in White Rock between Rover and Grand Canyon. This section of road connects residential areas and is popular for walkers on an improved side walk; "above average."

Site 4, Top of Jemez Road: A warehouse would increase traffic of large trucks in this area that includes parking, badge office, access control, and various other Lab support activities. The truck route is built for the large vehicles, and new truck lanes have been installed for the Park and Ride system. An added traffic light for the warehouse would be required for safety and allows a score of "excellent." *Site 5, TA-61 Pit:* access to the site is on a steep slope, and turning and accelerating lanes would be needed. Trucks are typical for the road; "average." *Sites 6 and 7, Sigma West and East:* "excellent."

Site 8, E. Jemez/NM 4: "excellent." *Site 9, San I:* "above average." *Site 10, DP Road:* The major issue is how to connect with DP Road. Using a redesigned Trinity Drive connection scores "above average."

LANL Operations/Land Use Sub-Criteria

Compatibility with Comprehensive Site Plan.

Site 1, DOT: NNSA-LASO will probably not accept this site because it is scheduled for transfer to the County. This means DOE has stated that land is no longer needed and can be transferred. Requesting access to this land from the County again might be politically difficult. Although this is not exactly conflict with LANL's site planning, it certainly conflicts with

[3] Road safety scores partially based on information supplied by Chrystal Rodarte, FWO-UI, personal communication, January 5, 2004.

DOE's site planning. Score is "below avg." *Site 2, Pajarito Road North:* No conflict; score is "finest." *Site 3, Pajarito Road South:* No conflict; score is "finest."

Site 4, Top of E. Jemez Road: There are major planning conflicts with this site including a new badge office, the security perimeter road, access control, parking structure and lots, fire station, etc. Score is "unsatisfactory."

Site 5, TA-61 Borrow Pit: This site is currently active for rubble and soils storage and removal, and will remain so in the future. A warehouse there would force the current operations to go elsewhere. Also, this site is one that LASO has offered to the County for consideration for a sanitary landfill. The County is currently examining it for geotechnical suitability. If NNSA pulls the site back from the County there would be political1 problems. TA-61 scores "poor." *Site 6, Sigma Mesa West:* There are current plans for constructing a KSL support building (offices) in the vicinity with no expected conflict. The warehouse function is appropriate for the area. Score is "excellent." *Site 7, Sigma Mesa East:* The nearby asphalt plant at the eastern end of the mesa is mobile and could be moved to avoid conflict with a warehouse. Appropriate development of the mesa; score is "finest."

Site 8, E. Jemez Road./NM 4: No conflicts, score is "finest." *Site 9, San Ildefonso:* No conflicts, score is "finest." *Site 10, DP Road:* This location is not compatible with present land use plans. Score is "average."

LANL Security Impacts.
Sites on the LANL perimeter score higher than those farther away. If a site is located away from the perimeter, LANL vans will still need to negotiate public roads after an initial security inspection and therefore are more vulnerable to terrorist attack/infiltration. The farther away a site is from the perimeter, the lower the score. S-DO says that the Sigma Mesa sites are sufficiently far from TA-55 and can continue to be considered. S-DO also wants the warehouse within 15 minutes response time for PTLA.

Site 1, DOT: The property will be transferred to Los Alamos County, and "clean" warehouse trucks must traverse public roads under Santa Fe county, pueblo, and state jurisdictions. The combination of jurisdictions rates "poor." *Site 2, Pajarito North:* I assume delivery trucks will use Pajarito Road to access TA-3, which means the "clean" trucks are on Lab-controlled property; score is "excellent." *Site 3, Pajarito South:* same as Site 2: "excellent."

Site 4, Top of E. Jemez Road: Although on the perimeter, this site is close to TA-3 and other critical LANL operations; score is "poor." *Site 5, Borrow Pit:* PTLA response time is good, and it is not far from the LANL perimeter so distance on public roads after inspection is minimized. Route passes Royal Crest Park; score is "excellent."

Site 6, Sigma Mesa West: The Beryllium Technology Facility (BTF) is located on Eniwetok Road and might be close to the new access road. BTF is not a proliferation issue, so it is not as much of a problem as TA-55. The warehouse site is on the LANL perimeter, but near a critical facility; score is "average." *Site 7, Sigma Mesa East:* This site is more secluded from LANL facilities and yet is close for security response; score is "excellent."

Site 8, E. Jemez Road/NM 4: Score for this site is "excellent." It is just a few miles farther from the perimeter than Site 5 and it gets the same score. *Site 9, San Ildefonso:* There are jurisdictional problems with the route and site; score is the same as for Site 1, "poor." *Site 10, DP Road:* jurisdiction problems coupled with lack of security for the trucks as they must drive up E. Jemez, across the bridge, and pass through town. Score is same as for Site 1: "poor."

LANL Operations Impacts.
This sub-criterion includes the efficiencies of being located near key LANL delivery areas defined as TA-3 and the Pajarito Corridor, as well as interference with existing lab operations.

Site 1, DOT: There are no conflicts with present or future LANL operations because NNSA is planning to transfer it. The distance to delivery areas is approximately ten miles; score is "poor." *Site 2, Pajarito North:* easy to deliver throughout Pajarito Corridor using smaller vans, although large trucks will have a problem with the curved hill road at TA-18. For Lab employees picking up items, road blocks are occasionally encountered on Pajarito Road. So distance is not far for customers or warehouse distribution; score is "excellent." *Site 3, Pajarito South:* same as Site 2; score is "excellent."

Site 4, Top of E. Jemez Road: Very convenient and close to TA-3, but there are parking problems and congestion. Score is "above average." *Site 5, Borrow Pit:* excellent location, close to TA-3, but with no congestion. Assuming the borrow pit operations can continue there after warehouse is built, score is "excellent."

Site 6, Sigma Mesa West: "excellent" location to TA-3. *Site 7, Sigma Mesa East:* Also scores "excellent." *Site 8, E. Jemez/NM 4:* Has good access to both TA-3 and Pajarito Corridor, score is "excellent." *Site 9, San Ildefonso:* The pueblo's jurisdiction means they could shut us down; score is "poor." *Site 10, DP Road:* This site has the most difficulties in distance and traffic congestion for deliveries and pick up; score is "poor."

Economic Sub-Criteria

Infrastructure Development Cost.[4] Roads and sewer infrastructure are the most costly. Table 5 lists the nominal scores for each type of infrastructure for the ten sites.

Site 1, DOT: Water can be accessed from LA County's nearby Otowi Well #1. The County also has a 13,200 volt power line that runs through Los Alamos Canyon, plus the existing DOT buildings have power access. There is an eight inch PNM natural gas transport pipeline that follows NM 502. To get access to this line would require DOE/PNM negotiations that in

[4] Charles Trujillo and Crystal Rodarte (FWO-UI), personal communication, January 5, 2004.

past cases have been very time consuming, on the order of five years. The best solution might be to use propane (about three times more expensive than gas per BTU) until the gas distribution contract can be negotiated. Communications can be obtained from the large capacity line from Santa Fe located in Los Alamos Canyon. Sewer access is not a problem, but will require a lift station and a pipe up the nearby dirt road to the sewer plant in Pueblo Canyon. Road access to this site will be extremely difficult and expensive. Delivery trucks will have to continue to the lab via East Jemez Road because NM 502 is not designed for heavy, slow traffic. Score is "below average."

Sites 2 and 3, Pajarito Road/NM 4: Water can be accessed from the south side of the intersection of Pajarito Road and NM 4 without much expense. The 13,200 power line that runs across TA-36 provides easy access for electricity. The nearby gas line is owned by Los Alamos County and would require an agreement for distribution hook up. For communications, easy access can be made to the line that runs above ground on the power lines across TA-36. Sewer access is nearby in the residential areas. In terms of required road improvements, these two sites encounter significant traffic, but are located on a main road. Deliveries to LANL will still have to use East Jemez Road because the improvements to Pajarito Road to allow heavy trucks would be over $1M. There is space for deceleration lanes and the road is already controlled for speed. Site 3 is on a state-maintained road so additional negotiations for maintenance will be needed. Overall score is "excellent" for both sites.

Site 4, E. Jemez and Diamond Dr.: All utilities are easily accessed because of the site's proximity to TA-3. A traffic signal will have to installed for this site because of already congested conditions. The warehouse trucks are already using E. Jemez Road for TA-3 warehouse access, and make up about 1/30 of the total traffic flow. It would not be difficult or expensive to put in a warehouse access road at this site. Score is "finest."

Site 5, Borrow Pit: An 8-inch water line runs on top of the LANSCE mesa and would have to be brought across E. Jemez Road to the Borrow Pit. Electricity could come from the 13.2kv line on Sigma Mesa following the gas corridor across the canyon. The site has easy access to natural gas (a line crosses the site from Sigma Mesa toward LANSCE). Communication would have to be extended from LANSCE as well. Sewer is a problem with this site. A leach field might be possible, or perhaps a lift station up to LANSCE. Another option is a small self-contained, turn-key, aerobic sewage plant to serve the site. Cost will be high to build a road entrance given that the site has a steep grade on East Jemez Road and there is no room for an acceleration lane because of the canyon to the south. A new intersection there is not impossible but will be expensive. Expensive road and sewer access scores "poor."

TABLE 5
Relative Ranking for Infrastructure Development Cost

Site	Water	Electric	Gas	Communications	Sewer	Road
1	Finest	Finest	Poor	Excellent	Above Avg.	Poor
2	Excellent	Excellent	Average	Excellent	Finest	Above Avg.
3	Finest	Finest	Average	Finest	Finest	Average
4	Finest	Finest	Finest	Finest	Finest	Excellent
5	Average	Average	Finest	Average	Poor	Poor
6	Finest	Finest	Finest	Finest	Finest	Unsatis.
7	Excellent	Finest	Excellent	Above Avg.	Above Avg.	Unsatis.
8	Excellent	Excellent	Poor	Excellent	Poor	Above Avg.
9	Above Avg.	Above Avg.	Poor	Excellent	Poor	Average
10	Finest	Finest	Finest	Finest	Below Avg.	Below Avg.

Sites 6 and 7, Sigma Mesa West and East: Water access will be easy for the west site, and a little harder for the east site. A 12-inch water line extends to the rack facility, and a 2-inch line to

the pesticide storage shed, TA-60-29, about 2,400 feet from the warehouse eastern site. Bringing water from this source to the east would not be too expensive since it is a gravity feed. An alternative water supply would be the E. Jemez Road line, which entails crossing Sandia Canyon and pumping water up the gradient.

Power is easily accessed at Sites 6 and 7. Gas access will be easy for both sites. There is a high pressure 6-inch steel gas line that crosses the mesa west of the proposed landfill site; will not be expensive to tap it. Plus the west site is close to other buildings with gas lines. Communications will be easy for the west site, but a bit longer line extension for the east site. Sewer tie in will be easy for the west site, and the east site will require more pumping up-gradient.

Road access to Sites 6 and 7 requires road building using one of the three options. The least expensive is to use the rubble fill bridge near the landfill. But it will be difficult to bring this road past the Beryllium Technology Facility because of both safety and security. A past study by FWO-UI for this road encountered these issues and dropped the project because of the difficulties. If the BTF issue could be handled somehow, then the score for road cost would be "average." But if the other two alternative roads must be used (bridging the Sandia Canyon south of the Borrow Pit or coming up the canyon from E. Jemez Road) the cost will score "unsatisfactory." The dirt road on top of Sigma Mesa is narrow and would need widening. There are some archeological issues with road expansion there. Overall, the good utility access combines with an expensive road scores "unsatisfactory" for both sites.

Site 8, East Jemez/NM 4: Water access will be easy from a pipe along the road from the corner of Jemez and NM 4 or from the pump station (?) on E. Jemez Road. Electricity is available from the firing range or the County's pump house. The natural gas access will require a DOE/PNM agreement for access to the PNM gas transport line on NM 4. So propane must be used initially until the agreement is in place. (Other options to get gas from the borrow pit line or from LANSCE are expensive,

over $1M.) Communications can be obtained from LANSCE or the line in Los Alamos Canyon, and a line can be run on existing poles overhead. CCN-4 estimates this task to cost ~$500k. Sewer must rely on a leach field[5] or a small treatment plant because there is no access available. Road access will require an intersection with acceleration and deceleration lanes, but no traffic signal. The road is wide and flat, with no drop-off, good for snow removal, and is under LANL jurisdiction. The overall score is "average."

Site 9, San Ildefonso: Water access will be harder than for Site 8 because of extra distance. Electricity is available along NM 4 but it may be PNM's line which will require special negotiations. Gas is the same situation as with Site 8. Communication will be easy from the Los Alamos Canyon line. Sewer lines are not available leach fields or a turn-key plant must be used. NM 4 is not maintained by LANL, so additional truck lanes would require negotiations with the state on how to pay for maintenance and snow removal. The road access design would be similar to Sites 2, 3, and 8. Score is "below average."

Site 10, DP Road: Water, electricity, gas, and communications will all be easy because of existing facilities nearby. Sewer will require a run up DP road and a tie to the County's system. The road is in terrible shape now, narrow, poorly maintained, and the intersection with Trinity is bad. Businesses currently have traffic backing into DP Road. Delivery trucks would have to use E. Jemez Road because NM 502 is unsuitable. Site 10 would cause more truck traffic on the Diamond Drive bridge. A new bridge to access E. Jemez would make this site the most expensive option for this criterion. But I assume this will not be needed. Score is "average."

Regional Economic Development.
A small site of only five acres that precludes participation of a third party building, scores the minimum required on Land

[5] The leach field design must account for snow coverage during winter (the site is shaded by southern bluffs) and perched water at ~500 feet below the surface. (Per David Broxton e-mail, February 9, 2004.)

Availability, but scores "unsatisfactory" that is, a zero, on this criterion.

Site 1, DOT: good location and access; score is “excellent.” *Site 2, Pajarito Road North:* Score is “unsatisfactory” because there is only 6.2 acres available, not enough space for a third party to develop. *Site 3, Pajarito Road South:* scores “excellent” because there is a hotel nearby with residences and shopping.

Site 4, Top of E. Jemez: “unsatisfactory” because of no available space for a third-party. *Site 5, Borrow Pit:* This is a main artery for the county, suitable for industrial development, but the location is a bit hidden behind natural sight barriers; score is “above average.” *Sites 6 and 7, Sigma Mesa West and East:* Both score “average” because they are on a road interior to LANL with little traffic exposure.

Site 8, E. Jemez/NM 4: Better visibility than Site 5; score is “excellent.” *Site 9, San Ildefonso:* Same score as Site 8; “excellent.” *Site 10, DP Road:* Close to downtown, but out of sight down the road similar to Sigma Mesa; score is “average.”

Results

The weights for the criteria and the scores of the alternatives are combined to create the final results of the decision model. The scores described above and in Table 4 are normalized in a similar fashion to what is done with the weights. That is, the scores of the ten warehouse alternatives against one sub-criterion are recomputed so that the ten scores add to unity. For each sub-criterion this is done by dividing each alternative’s score by the sum of the ten scores. For example, the (rounded) scores against Biological Impacts are: DOT (83), Pajarito North (83), Pajarito South (83), E. Jemez/Diamond (50), TA-61 Pit (33), Sigma Mesa W. (17), Sigma Mesa E. (17), E. Jemez/NM 4 (83), San I. (100), and DP Road (33). The sum of the ten scores is 566. Therefore, the normalized score for Sites 1, 2, 3, and 8 is 83/566 = 0.15, and that of Site 4 is 50/566 = 0.088, and so on. These scores are listed in Table 6.

The decision score is found by computing the weighted sum of the scores of each alternative. The information needed for this calculation is shown in

Table 6. The column for each alternative has the normalized scores for each sub-criterion. The sum of an alternative's scores against all the sub-criteria multiplied by their appropriate weights is the total score shown in the bottom row. The chart in Figure 14 shows these results.

Five of the alternatives have red bars in Figure 14, which signify a violation of one or more rules in the model. Rules are defined to highlight important sub-criteria where a score of *Unsatisfactory* indicates a major problem with that alternative. In this model four rules are defined, as shown in Table 7. Even though an alternative may score very high against many sub-criteria and have a high total score, a violation of a rule indicates a major potential problem exists in developing a warehouse at that site. In coloring the score bar red in Figure 14, the reader can see the final score but also the fact that a potential "show-stopper" issue exists. Pajarito North is in an area with a concentration of pueblo ruins and so violates the rule "Cultural Impacts." Pajarito South is located across from residences as scores unsatisfactory on Public Acceptance. Site 4, E. Jemez/Diamond is less than 2 acres and so violates the "Available Land" rule; it also scores "unsatisfactory" for Compatibility with Comprehensive Site Plan and Regional Economic Development sub-criteria. The two sites on Sigma Mesa face major infrastructure expense to build an access road to the warehouse. This causes a score of zero for Infrastructure Development Cost.

Of the five sites that do not violate rules, two are ranked first and second out of the ten: E. Jemez/NM 4 (Site 8) and San Ildefonso (Site 9). Site 8 scored consistently well on all the sub-criteria--the lowest score it received was "average" for Infrastructure Development Cost. This is because of the lack of sewer hook up nearby. Consequently, it is clearly the top choice for the warehouse site. Site 9 scored "poor" on two sub-criteria (Security Impacts and LANL Operations) and "below average" on Infrastructure Cost. For this site to be chosen for the warehouse, significant NNSA/UC/Pueblo legal issues relevant to security and operation must be resolved. Important questions must be answered about the storage of classified materials on sovereign nation land and contractual protections for continuous operation.

TABLE 6
Normalized Scores for the Ten Warehouse Alternatives

Sub-Criterion	*DOT*	*Pajarito North*	*Pajarito South*	*E. Jemez/ Diamond*	*TA-61 Pit*	*Sigma Mesa W.*	*Sigma Mesa E.*	*E. Jemez/ NM 4*	*San I.*	*DP Road*
Biological Impacts	0.14	0.14	0.14	0.09	0.06	0.03	0.03	0.14	0.17	0.06
Available Land	0.18	0.03	0.06	0	0.12	0.06	0.12	0.12	0.18	0.12
Cultural Impacts	0.14	0	0.02	0.12	0.14	0.10	0.10	0.10	0.14	0.14
Public Acceptance	0.11	0.07	0	0.11	0.13	0.13	0.13	0.09	0.09	0.13
Accidental Exposure	0.20	0.07	0.03	0.03	0.10	0.07	0.13	0.17	0.17	0.03
Vehicular Accidents	0.03	0.10	0.10	0.12	0.07	0.12	0.12	0.12	0.10	0.10
Compatibility with Comp. Site Plan	0.05	0.14	0.14	0	0.05	0.12	0.14	0.14	0.14	0.07
Security Impacts	0.03	0.16	0.16	0.03	0.16	0.09	0.16	0.16	0.03	0.03
LANL Operations	0.03	0.14	0.14	0.11	0.14	0.14	0.14	0.14	0.03	0.03
Infrastructure Devel. Costs	0.07	0.19	0.19	0.22	0.04	0	0	0.11	0.07	0.11
Regional Econ. Development	0.15	0	0.15	0	0.12	0.09	0.09	0.15	0.15	0.09
RESULTS	**0.10**	**0.09**	**0.10**	**0.08**	**0.10**	**0.09**	**0.11**	**0.13**	**0.11**	**0.08**

Note: Each criterion row adds to 1.0. Normalized scores are computed by dividing the single alternative's score by the total of all alternative scores, e.g. for DOT against Biological Impacts, 83/(83 + 83 + 83 + 50 + 33 + 17 + 17 + 83 + 100 + 33) = 0.14.

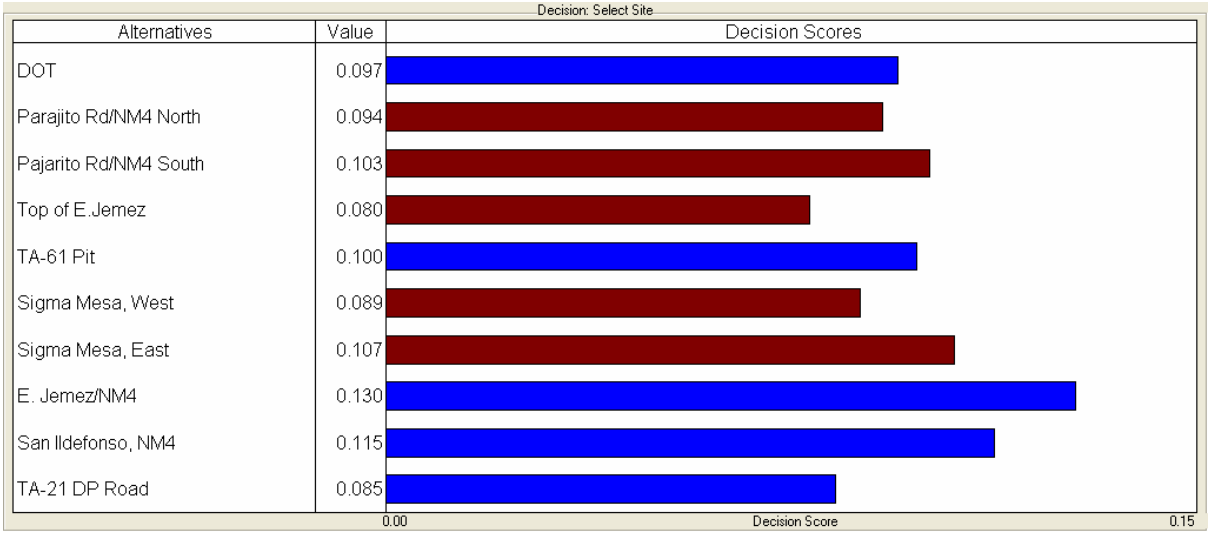

Figure 14: There are five possible sites for a new LANL warehouse, shown in blue in the decision analysis ranking chart. Red bars signify that the alternative scored "unsatisfactory" on one or more important rating criteria.

TABLE 7
Rules for Important Sub-Criteria

Rule Name	***Definition***
Size	**Available Land** must be better than *Unsatisfactory*.
Cultural Impacts	**Cultural Impacts** must be better than *Unsatisfactory*.
Public Acceptance	**Public Acceptance** must be better than *Unsatisfactory*.
Infrastructure Costs	**Infrastructure Development Costs** must be better than *Unsatisfactory*.

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